Pit and Quarry

SAND-GRAVEL-STONE
CEMENT-LIME-GYPSUM

Pit and Quarry

Published Every Other Wednesday for Producers and Manufacturers of Sand Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

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Vol. 13 CHICAGO, ILL., FEBRUARY 2, 1927 No. 9

THE 1927 PIT AND QUARRY HAND BOOK

Bigger and better than any previous edition, the 1927 HAND BOOK is now being printed and will be ready for distribution about the middle of February.

TENTH ANNUAL CRUSHED STONE CONVENTION REFLECTS NEW VIEWPOINT IN INDUSTRY

LOOKING back over the Tenth Annual Convention of the National Crushed Stone Association held in Detroit at the Book Cadillac Hotel from January 17th through January 20th, we feel that it deserves more than any previous crushed stone convention the honor of being the greatest crushed stone convention ever held. The attendance passed the 500 mark. The program was so full that little time was permitted for discussion. This convention represented a wonderful achievement in organization as the officers succeeded in bringing problems concerning facts, theories, market conditions, etc., to a common center with the time and energy of a great attendance concentrated upon them. This organization is a highly important power in business and will work with the same influence for the National Crushed Stone Association. The Association itself was the center of affairs at this convention which is as it should be. The random talker, who distracts the attention of others from the subject under consideration, was noticeably absent.

The convention sessions were held on Monday morning, Monday afternoon, Tuesday, Wednesday and Thursday mornings. Group luncheons were held on Tuesday and Wednesday. These luncheons were divided into salesmen, operating men, and agstone producers. Two general luncheons were held, one on Monday and another on Thursday. An interesting part of the convention was the manufacturer's exhibit which formally opened on Monday evening and remained open throughout the convention. A smoker was held on Monday evening, a theatre party on Tuesday evening, and a banquet on Wednesday evening.

The convention took a forward step on Thursday morning when it approved a dues schedule arranged to increase in direct proportion with a member's annual tonnage. This schedule was submitted by the Board of Directors for use only as a guide. The same system of dues calling for $25 per membership is still to be in force. However, the schedule approved will enable a member company to determine how many memberships it should carry to properly support the work of the Crushed Stone Association. This schedule is as follows:

Annual Tonnage	Suggested Support
0– 50,000	$ 50.00
50,000– 100,000	100.00
100,000– 150,000	150.00
150,000– 200,000	200.00
200,000– 250,000	250.00
250,000– 300,000	300.00
300,000– 350,000	350.00
350,000– 400,000	400.00
400,000– 450,000	450.00
450,000– 500,000	500.00
500,000– 750,000	750.00
750,000–1,000,000	1000.00
over 1,500,000	1500.00

Two new regional vice presidents were elected. Otho M. Graves was unanimously reelected President. A remarkable tribute was paid Mr. Graves in this reelection as it marks his third successive term. H. E. Baer as toastmaster at the annual banquet stated that the nominating committee did not even consider nominating any other candidate. At the opening of the convention, again at the banquet and again by resolution, tribute was paid to J. J. Sloan and F. W. Schmidt, two past presidents of the Association who passed away since the previous convention.

President Graves opened the convention at 10 o'clock on Monday morning. Mr. Reed, Director of Public Works, City of Detroit, welcomed the delegates in the absence of the mayor. This welcome proved very cordial and incidentally interesting be-

cause Mr. Reed spoke briefly of the tremendous program of construction being undertaken by the City of Detroit. He spoke particularly of the sewer and paving construction programs. For the past three years Detroit has laid an average of 112 miles of pavement each year and according to Mr. Reed has had some difficulty in securing a hard clean stone, which fact is quite a surprise.

President Graves' Address

President Graves in his address briefly summarized the year's activities of the officers and committees and offered a few suggestions to the Association concerning activities and policies during this year. Those remarks, which appeared to be most significant, have been selected for publication here.

"Perhaps the outstanding activity of the year was the trip through the Middle West, the Northwest, Pacific Coast, Southwest and the Southeast of the officers of the Association. It is proper that you should know that the trip was taken in response to a request by the Board of Directors meeting in Atlantic City last July. After considerable thought on the matter, it was deemed wise to undertake that for the purpose of endeavoring to ascertain to what extent an association could be more helpful and serviceable to the industry in the more remote sections of the country, remote as far as your Washington office is concerned, and if it be found that the association could be of sufficient material value to the producers in those sections of the country to ask that that fact be reflected in an increased financial support not only through the medium of new members but also by an increase in the memberships of our present members.

"We started the trip in Chicago without holding a meeting there, and our regional Vice-President, Mr. Sanborn, went with us to the meetings in St. Paul, Madison and Omaha. He left us there and came back, and we went on through Cheyenne, Denver, Salt Lake City, Portland and down through the Pacific Coast, through the South and up again. I think it is only right to state that your representatives were received with the greatest cordiality and hospitality throughout the trip.

"It was rather impressive to me to note the extent of the interest of the highway departments, the engineering societies and the Chambers of Commerce and Boards of Trade. The highway departments were, of course, particularly interested in the fact that Mr. Goldbeck was with us, and although we had a far larger attendance at each of our meetings of those actively engaged in this industry than I had expected would be the case, nevertheless fully half of each meeting would be composed of engineers either in general construction work, contractors, or from the state highway department.

"The response to our request for membership was most encouraging. We have felt during the past year the need in Washington of a preliminary testing laboratory for our Bureau of Engineering. The need is an insistent one to my mind. It is almost vital for the most effective work that can be done by the Bureau of Engineering, and it was largely because of the need of raising the money for that additional opportunity to function that I persuaded myself as to the value of taking that trip, and of course we did it with some doubt, with some hesitancy as to whether or not we might not be wasting the funds of the association which must be conserved with the greatest care in taking so elaborate a trip.

"I am very glad, however, to be able to tell you that we secured on the trip, without any undue pressure or any undue urging some 130 memberships as a result of that trip, and more are coming in. It is difficult to estimate just how many will result from it, but 130 are assured and I think that before another three months is past it will have reached 150.

"At the convention at Cincinnati, harking back two years, and I am very apt to do that in these matters I am reporting on, we were charged with the duty of maintaining a closer contact, a closer alliance if that be possible, with the technical societies and institutions of the country in which we might properly be interested and in which our influence might be properly exerted. Summarizing briefly let me indicate that this Association, either through personal membership or through the Association itself as circumstances might necessitate, is represented by Committee C-9, concrete aggregates and sub-committee of the American Society of Testing Materials, and on subcommittee five of that committee. Committee E-1, methods of testing, and Committee D-4, of the same society on bituminous road materials. Mr. Goldbeck has just been appointed a member of the committee on awards for the best paper submitted to the American Society of Testing Materials. Mr. Goldbeck is also chairman of the Structural Design Committee of the National Highway Research Board, to my mind a committee which has a greater influence on highway design than any other group of men in the country today. We are also represented on the Committee on Research of the American Society of Civil Engineers, on the joint committee on Concrete and Reinforced Concrete appointed by the A. S. T. M.; also on the American Engineering Standards Committee which is doing a great deal of authoritative work on the question of standardization. We also are on the Committee on Aggregates of the American Concrete Institute and on a so-called Sectional Committee on Tests for Road Materials which is sponsored by the American Society of Testing Materials and is composed of representatives from various technical societies,

institutions and from trade associations, a committee whose work will be felt, I think, in the very near future.

"The standing committees, to which one new one has been added, have been as active this year as heretofore. The Committee on Research, of which Mr. Mckee of Pittsburgh is chairman, held a meeting in Washington, and the Committee on Standards, of which Colonel Chamberlain of Chicago is chairman, subdivided its work even further this year than it did last year, and this year there were three active subcommittees, a subcommittee for the standardization of drilling equipment which we had last year, a subcommittee for the standardization of commercial sizes of crushed stone, a question which perennially with us and manifests itself in every committee formed, and a subcommittee for the standardization of quarry tracks and cars.

"There are also appointed in Montreal a Committee on Criticisms and Suggestions as to the conduct of our annual conventions, or anything else that they might care to comment on. That Committee is under the chairmanship of Albert Worthen of Connecticut who circularized our membership and made a symposium of the comments and forwarded them to us, unfortunately somewhat too late to permit us to avail ourselves of the very excellent suggestions made. So if, in the conduct of this Convention, we seem to continue to violate some of the things which you think should be changed, we hope you will look upon it with a lenient eye in view of our not having known your opinion in time to use it. Some of them we were able to adopt and weave in the fabric of this Convention, and they may appear later.

"The Associated General Contractors of America invited us to send a representative to a meeting of their Board of Directors in Kansas City to consider with them the question of the winter storage of crushed stone largely from the point of view of storing on the job. Their invitation came as a result of a considerable amount of work initiated by this Association along that line of research. Mr. Sanborn, our Vice-President of the North, was our representative and a very able one as you would of course expect.

"During the past year we have had no Membership Committee. That somewhat was due to a feeling of loss sustained by the presiding officer caused by the resignation of Colonel Tyler of Kentucky. Colonel Tyler worked so tremendously on the Membership Committee the previous year that we delayed appointing a committee in the hope that Colonel Tyler would reconsider his intention to resign and continue this year, which he unfortunately did not do. That was part of the reason, and was also based on the thought that primarily the securing of new members and the handling of our membership in general should appropriately rest upon our Secretary.

"I should like to summarize to you the growth of the Association during the past two years, not from the point of view of saying, "Hasn't this been nice," but rather to indicate where we are going as regards our membership increases. If we could plot a chart by which we could prophesy the increase for a year or two to come it might assist us in determining to what extent the Association can enlarge its activities. The membership as reported to you two years ago in Cincinnati showed 80 firms (I am speaking now only of the active members) holding 171 memberships. Last year in Montreal the report showed 156 firms with 427 memberships, and this year we have 211 firms with an indeterminable number of memberships, but at least 575. Probably if that could be accurately determined it would be about 600, but that is as may be.

"The Associate members during that time have increased from 58 to 82, and so far as I konw, as I have said before, that has been entirely voluntary and without solicitation. A very proper criticism was urged several years ago that the perecentage of manufacturers in this Association was too high, too high to be of value to them and too high to be of value to us, that we were top-heavy in that regard. Therefore, as a matter of interest largely to myself, and possibly to some of you, I determined that two years ago the percentage of members in this Association of manufacturers, that is the percentage of manufacturing members or associate members, was 42.7 per cent. Today it is 28 per cent. It isn't that we don't want more associate members but we want so many more active members that that percentage will be kept sufficiently low that the membership of the associate members will be of even greater value to them.

"The Treasurer's report submitted by Mr. Savage will receive no comment from me at this time. It will be distributed. It was presented to the Board of Directors last night in printed form and each member of this Association will be given a copy, and if there are any questions to be asked you are at liberty, of course, to ask them at any time from the floor of this Convention or individually as you may deem best. I should like, however, to call your attention to the increase in finances because it seems to me that that is something we must bear in mind, not only because of the past but so far as it may be an indication of the future, and that is that the report in Cincinnati the previous year showed collections, that is receipts, of $8,451. In Montreal the receipts were $22,000 for the previous year, and this financial statement shows receipts of $32,000 which doesn't fully tell the story. I am not going into details as to why it doesn't because there is cash in the bank of $10,000 and also accounts receivable of $3,325, practically all being entirely good but falling due too late in

December to permit collection before this Convention, so that the essential thing, although it isn't so shown on this report and properly not so shown, we deduce from it is that our revenue last year was $41,000.

"The freight rate proceedings, in which this Association has found it advisable to inject itself, have not been so numerous this year as formerly. You, of course, all know that in proceedings Ex-Pare 87, Docket 1700 before the Interstate Commerce Commission, we have a petition to increase rates on certain commodities, and a greater increase on crushed stone, sand and gravel was denied. I believe all the evidence and arguments presented by this Association, as well as its sister association, the National Sand and Gravel Association, had something to do with that decision.

"Our Counsel appeared in argument before the Interstate Commerce Commission in that case and we were also interested in another proceeding called Docket 17,517, class rates on sand and gravel in the state of Georgia. It seemed at first to be of only local interest, but on examination we felt that it had a wider influence than might be manifested on the surface and consequently we appeared before the Interstate Commerce Commission and argued on that case only insofar as our interests were affected.

"The third freight rate matter to khich I would like to call your attention its somewhat interesting. This is Docket 15,212, a case brought by the National Slag Company against the Boston and Albany Railroad and other railroads, the Boston and Albany being named so as to name some plaintiff. All eastern railroads were concerned. We handled our own case in that matter in order to save counsel fees despite the saying that this is inadvisable, and we presented our own argument. I am going to read to you, because I think it is of rather vital interest, the concluding paragraphs of the report of the examiner to the Interstate Commerce Commission. Let me say for a moment that our sole position was that they were not arguing as to freight rates going up or down. We were not concerned for the moment with that. We had no interest in whether the rates were decreased as requested by the complainant or wether they were not. We only wished to urge that if the freight rates on slag or gravel were decreased, then let there be a corresponding decrease and an identical decrease in the rates on crushed stone, that there could be no transportation reason why either of the commodities, gravel or slag, could be moved at a lower traffic structure than was applicable to crushed stone. We were merely an intervener in that case, but the examiner went somewhat out of his way to say in this report to the Interstate Commerce Commission—

"There is no basis in this record for a finding respecting rates on crushed stone and, therefore, no recommendation is made concerning that commodity. Nevertheless it is abundantly obvious from exhibits of record that crushed stone is produced in the neighborhood of Bethlehem and Hokendauqua and that rates on crushed stone from such points or origin to the destinations here considered, particularly to destinations on direct lines to Jersey City, are not the same as those on slag now in effect and generally are higher than those specified in Appendix A, referred to above. In the Duquesne Slag Products case, cited, the commission corrected slag rates upon the basis of the Birdsboro scale on rates on stone. Unless the carriers are seeking additional complaints to defend it would seem that whatever basis of rates be adopted by the commission in this case should be made applicable as a maximum on crushed stone in the territory here considered."

"That is important, to my mind, because that is the first pronunciation of which I happen to know which has come for accepting the thing that we have argued for years, that there is no reason for discriminatory rates even though the slag was taken out in empty cars which had come in loaded, and that we should not suffer in an indiscriminatory fashion. It was, of course, gratifying to all of us to have it stated as clearly as it was, but that case, if the Interstate Commerce Commission accepts it, establishes a precedent which is of help to us.

"Here are a few statistics which I compiled because I was somewhat interest in it. During the last two years the President's office has written 5,590 letters. Some of you can well believe that, I imagine. That is an average of nine and three-tenths letters per day. This was difficult for me to believe myself, and therefore I don't ask you to believe it, except that you might be gratefully and graciously inclined, that the President traveled in the last two years 29,000 miles for the Association, which is an average of forty-eight and three-tenths miles per day. I don't propose to defend that statement other than to submit an itemized statement of the trips taken.

"There are one or two suggestions which I would like to offer as to the conduct of this Association during the next year. Its policies, of course, are determined largely by the Board of Directors because the Board of Directors can be assembled more easily than can a Convention, but we must always bear in mind that the final determining body is this membership assembled in these annual conventions, and it is for you at any time you see fit to instruct the Board of Directors, the officers of the Association, or whoever you may feel it wise to manifest your wish, as to what you want to have done. It is your Association and yours alone, and it is only going to be as strong as everybody wants it to me. A few men, of course, will stand behind the thing and work pretty hard for it for awhile,

but unless the whole membership is strongly in sympathy with what is being done the effort of a few is futile and wasted. Now, fortunately, in this Association I believe we all are working for approximately the same ends, and in the same way, and I would like to suggest, as I have on several other occasions and as I did throughout the country on this trip, that we need in Washington a preliminary testing laboratory. I discussed that at some length, I remember, at the Convention last year and it is perhaps unnecessary to go into details now other than to say this: That we are continuing, in my judgment, to make a serious mistake in keeping Mr. Goldbeck, an engineer who has spent his life in research work in close contact with laboratory and field research, who has had in his employ some eighty testing engineers in the Bureau of Public Roads, eighty brains to test out the theories and ideas and thoughts that might occur to him, behind a desk to write letters and make such trips as he may, divorcing him entirely from the laboratory from which his strength has come. There is so much to be done with the pre- that we would make various tests and send them out as the findings of this Association. They liminary testing laboratory, and I don't mean wouldn't be worth printing despite Mr. Goldbeck's reputation and his integrity as an engineer. It it was favorable we would send it out. If it was unfavorable we wouldn't. There is no such thought as that in my mind. It is vastly different, you know, from going to a highway department, or any advertising agency, or board in Washington and saying, 'I have discovered something which I thought would be interesting to follow in a line of investigation.'

"They say, 'Maybe it would. We are pretty busy now, though. If we get around to it we will think it over.' That is very different than saying, 'I have tried this in my laboratory, this line of research, and I have got the result. Don't you think it is of sufficient interest to warrant your continuing the experiments and publishing the findings when you get them?' There is also the difficulty of shooting at a target with a rifle or shooting with a shotgun using buckshot. Some of the shot may hit it, and some will spread and not hit it. We want to hit the target with a rifle. I feel Mr. Goldbeck must maintain, because of the danger of his engineering and scientific atrophy, a generation of his scientific faculties. I make this plea, of course, not for him but for the Association.

"We have, during the past year, itemized the cost of establishing such a laboratory and without going into the dollars and cents it would be approximately $20,000 to equip it. It would also cost us about $10,000 a year to maintain it. It is costing us at present to run this Association about $40,000. I think we have a $1,000 balance in the bank now. To establish a laboratory, then, would require $20,000 and then annual income $20,000 greater than our present income or $51,000. We should also have a reserve set up for emergencies of at least $9,000 or $10,000 more so that our annual income should be $60,000, and it seems to me, gentlemen (and I want to depart just a moment to say that that is a very modest expectation for an increase of this size. This industry, it is estimated, will have produced in 1926, from estimates coming from the Bureau of Mines, 122,000,000 tons of stone of which approximately 100,000,000 or a little more will have been used in concrete construction, highway construction and railway ballast. There must be an investment in this industry, as near as can be estimated—and this is not an offhand statement—of some $250,000,000. There must be an annual payroll of some $10,000,000 or $12,000,000), an industry of that size, of that magnitude, of that basic importance as we know it to be, surely can raise $60,000 or $70,000 to safeguard its markets and to promote and extend further markets. It seems to me that is a very modest expectation and my opinion in that regard is being confirmed by our continually and continuous increase in revenue, but it cannot continue unless we all help to do it. Frankly, there are too many memberships of one or two each that ought to be higher and the burden is falling somewhat too heavily on those companies that have been willing to assume it in order to help get this thing under way somewhat upon our assurance that in time the whole membership would get its united shoulder under the burden so that it would be no more than a feather on the shoulder of each of us and create an aggregate which would give us an income ample to do the things that can be done to better promote the interests of the industry.

"In that connection the Board of Directors at Atlantic City and at its meeting last night, and also the Executive Committee's meeting, have considered a revised plan of dues. A report will be later made to you as to that and I ask for it, when it is made, your closest attention, and if possible, your kindly sympathy for it. It is an effort on the part of the Board of Directors to determine a plan of dues based still on our memberships of $25 each but somewhat indicating on a tonnage basis in even 50,000 tons the amount of money which if contributed for that tonnage would give to this Association an income of some $60,000, $55,000 or $60,000, and if we all subscribe to that basis as it is indicated I think it would be not only an equitable distribution of the financial burden, but that also it would be so light upon each individual company and so adjusted to the ability of that company to pay that the burden would be no heavier on one than on the other, and not in the least heavy on any.

"We have also been considering, and have not accomplished it for lack of funds, placing a re-

search engineer in the Bureau of Standards. I think this should be done, and I merely suggest it for consideration by those who are to come in for the ensuing year. I would simply like to go on record at this time as believing that this Association should have a research engineer in the Bureau of Standards. I am not defending that opinion, but merely stating it.

"As to freight rate matters, I think this Association is making no mistake in watchfully observing all the general freight rate movements, not in individual or local sections, but the general trend of structural rates in order to see that no discrimination be placed against crushed stone, not intentionally perhaps but inadvertently or thoughtlessly or without knowing the effect it would work if certain things were done.

"There should be certain modifications of the

Constitution and By-Laws. It will be necessary to modify it if it will be your pleasure to adopt the resolution in the proposal of the dues. I am also strangely of the opinion that we should have a regional Vice-President of the Southwest."

Business Conditions in 1926 and the Outlook for 1927

The directors of the Association reported upon business conditions in 1926 and the outlook for 1927, particularly as affecting their territories. The directors reporting and their comments follow.

H. E. Blair (Toledo, Ohio)

Report of production and sales conditions prevailing during 1926 and the outlook for 1927 in northern Ohio, southern Michigan and northern Indiana: Operation conditions were normal; that

is, no noticeable improvement in operating methods or costs of production were effected. A number of new plants or old locations were built and others are being built to improve the preparation of the product as well as reduce future operating costs.

Labor and transportation service were satisfactory. The extremely wet season had the effect of causing an irregular movement in the commercial field and plants depending on this market alone were affected by increased costs. Generally, however, plants enjoying all forms of business gained through increased production and sale of ballast, chemical stone, concrete sales, etc., offset the loss in the commercial markets. The demand for agricultural products decreased over the year previous caused by weather conditions. A number of firms were quite successful in developing new markets for what is known as by-products.

As no serious halt in general business activity in this section and elsewhere is anticipated, there is every reason to believe the transportation lines will be authorized to carry through a very large program of construction planned for 1927 consisting of ballasting, double tracking, grade separation and yard development. The various states, counties and municipalities have provided for an enlarged financial budget. Old increased demands in the road and street construction field are anticipated. Allowing for an improvement in weather conditions, the agricultural market should consume normal requirements as well as allowing for an increase to cover partial shortage in 1926.

Building activity in this section shows a steady annual increase which creates an annual increase of stone products for this purpose. Assuming business conditions remain normal, a market for a large tonnage of Flux stone and chemical stone should be provided.

A number of firms are carrying over into the construction season a very large percentage of uncompleted contracts all of which summed up with an anticipated increased demand in all markets leads us to conclude that the production and sales for 1927 will be above normal and very likely consumption will exceed any previous year in the history of the business. New plant and machinery installations planned and now being made along with increased production and demand should have the effect of reducing costs, but in view of the demand and the uncertainties of deliveries a price reduction isn't wise.

Harry Brandon (Piqua, Ohio)

The work has been good; very little price difficulty. The most serious difficulty we had was the very, very bad weather conditions during August and September. In our portion of the state there were twenty-three days of rainfall in September which held down our tonnage. If there is anything like favorable weather conditions we ought to start in producing a good tonnage at an early date. There is ample work in progress, proposed work in Ohio. Railroads in western Ohio have very large appropriations for improvements of all kinds, track elevations, double track improvements, and so forth, and generally speaking I would say 1927 is a very promising year.

L. R. Cartwright (Indianapolis, Ind.)

My remarks are confined to central Indiana and Illinois, which territory is served by our operations. All producers were alike affected with excessive rains through the late summer and fall, which seriously retarded construction work. The result is that many jobs remain uncompleted and most of us have contracts for considerable tonnage which will not be delivered until spring; thus insuring a fair amount of early business for 1927.

These same weather conditions made it impossible for the farmer to use agricultural limestone, which practically cut in two the demand for this product. If weather permits, we believe there will be an increased call for agricultural limestone in '27. To no small degree this improved condition is due to the untiring work of Mr. J. R. Bent of the Illinois Agricultural Association, who for years has been preaching the gospel of lime for sour soils. An increased state highway program in both Illinois and Indiana will, we believe, give increased tonnage for this year.

Those of us attending this Convention who are interested in highway construction in Indiana, because of conflicting dates, cannot attend our annual road school. I do not know whether other states provide for anything of this nature, but it is an institution which might be well copied by all states. All county highway superintendents and county engineers are compelled by law to attend and the meetings are attended as well by state highway engineers and superintendents. The road school is directed by the highway department of Purdue University and is addressed by many experts on all lines of highway construction and maintenance. The road school has meant much, particularly to our secondary highway system.

Unusual developments have been made during the last year in bituminous constructions and maintenance. Mr. Goldbeck has visited our territory and rendered valuable assistance in this direction. It seems that a low cost bituminous maintenance with a surface as smooth as any other type of construction has actually been accomplished. This will open for improvement a large mileage of secondary roads as well as better the construction of much of our primary system. In all, we look for good business this year.

O. P. Chamberlain (Chicago, Ill.)

The season for 1927 in the crushed stone industry promises better business than 1926, provided

contracts involving the expenditure of at least 25 per cent of the $100,000,000 Illinois State Bond issue are let within the next sixty days. Business will experience a notable pickup if the state highway department is able promptly to start this highway work.

It is the writer's opinion that building construction in the Chicago district will fall off as compared with 1926. There should, however, be a fair Chicago and Cook County business during 1927, probably 70 per cent of the 1926 business. It seems likely that the territory within a radius of 100 miles of Chicago, which is really the market for the Chicago district, will demand a much larger quantity of crushed stone for concrete aggregates and other highway construction work than in 1926.

The prospect for a large volume of agricultural limestone depends entirely upon the financial condition of the farmers. The farmers of Illinois know the value of agricultural limestone. They will purchase in good volume if their finances permit. The unfortunate weather condition in harvesting the 1926 crops was a serious drawback to the 1926 agricultural limestone business. The disastrous results of the wet fall season of 1926 will be seriously felt at least during the early part of 1927. Should crops be good and weather conditions be fine the fall of 1927 will see a great revival of the agricultural limestone industry in Illinois.

Prices of crushed stone in the Chicago district have gradually declined during the past three years. While some of us are optimistic enough to hope for higher prices for 1927 than prevailed last year, these hopes can only be justified in case the market expands substantially to the limits obtained in 1923 when there was a large volume of concrete aggregate delivered for state highway work. Frankly, the entire Illinois situation, both in regard to prices, market and volume of production and deliveries, lies in the hands of the state administration. Crushed stone manufacturers in the state of Illinois will press this administration for action on the expenditure of at least a reasonable proportion of the $100,000,000 authorized more than a year ago, none of which has yet been either expended or obligated.

C. M. Doolittle (Hamilton, Ontario)

The 1926 general conditions in Canada improved with a resultant beneficial effect on our industry. The earnings of the railways were greatly increased and their ballast requirements larger as a consequence of a better financial position. Labor was quite sufficient to meet all demands and its efficiency was fairly high. Transportation facilities were 100 per cent efficient, even at the season of greatest demand, namely, September, October and November.

Commercial users of crushed stone in Ontario are asking for a higher standard of aggregate, although we have not yet reached the point where Pit Run material has ceased to be serious competition. It is encouraging to us to know that twenty-eight states in the Union do not allow the use of this material, and with the assistance of Mr. Goldbeck, it is hoped that our educational campaign will soon result in more rigid specification.

Nineteen hundred twenty-seven prospects are such that an increase in tonnage is looked for. The road building program should be equal to, if not better than, 1926. Railroad requirements for ballast will increase and the demand for stone for building construction certainly should be better. No car shortage or labor scarcity is anticipated in the coming year. The demand for stone has increased during the past year and should be even better during 1927. It is not anticipated any attempt will be made to advance the prices, as it is felt by the operators that this healthy increase should be encouraged by a steady price.

The Federal and Provincial governments are reducing taxation as rapidly as possible and a considerable cut is looked for early in 1927. These tax reductions have a most helpful effect and any assistance from this quarter will result in better business for all.

I might mention here that the fee for all motor licenses in Ontario was reduced by $5 for 1927. The production of agricultural limestone was curtailed in 1926 owing to unseasonable weather in the spring and fall. The tonnage of this material to move next year should show an increase as on every hand a livelier interest is being taken in this product.

A further bond in the friendly relations between the United States and Canada will be cemented by the completion of the new Peace Bridge between Buffalo and Fort Erie in July of this year. His Royal Highness the Prince of Wales is coming to Canada to open this huge structure to traffic. One of the features of the bridge is the speed with which traffic may be passed through the customs. It is expected with the large bridgehead parking spaces (2½ acres paved) and the augmented customs staff on the Canadian side that congestion of tourist traffic will be largely overcome. In addition a traffic tunnel connecting Detroit and Windsor will be put under way in 1927. Increased traffic will mean greater expenditures on roads reacting favorably on our industry. The heavy traffic will undoubtedly raise large clouds of dust.

W. Scott Eames (New Haven, Conn.)

This report represents southern New England and part of New York City. Owing to the severe weather in February and March we did not open as early in the spring of 1926 as in previous years. We usually start up about the middle of March, but in 1926 we started about the first of April. Our demand after starting was immediate and kept increasing as the season advanced. The demand was much greater in 1926 than in 1925. All stone

producers in New England had a big year in 1926. This demand continued right up to the severe weather, which practically closed us down in December.

In New England we feel that 1927 will be equally as large as 1926. The price of stone is still very low in this section. This is due in a great measure to a large number of small producers scattered all over this section. The railroad company took care of us very promptly and gave us very efficient service. We had no such delays as we have experienced in previous years.

During the past year we had a conference in Providence, Rhode Island, with the state officials of Rhode Island, Massachusetts and Connecticut with Mr. Goldbeck. Following this conference we could readily see that Mr. Goldbeck's counsel was appreciated very much and it was a splendid help to the New England producers. The railroads used quite a large amount of ballast in the past year and they have a large program that is going to require at least one or two years more to complete.

F. T. Gucker (Philadelphia, Pa.)

Conditions in eastern Pennsylvania in 1927 will be about as they were in 1926.

J. C. King

Representing the territory comprised of the counties in eastern Ohio and western Pennsylvania: Business in 1926 was generally fair, although not so good as 1925. Prices eased considerably and there was keen competition among some producers for what roadstone was flowing. Prices became easier resulting in loss of money and the financial embarrassment of one or two small concerns.

Nineteen hundred and twenty-seven promises to be equally as good if not better than previous years. The steel industry looks forward to good business, at least over the first half, which will result in a strong demand for blast furnace stone. The amount of money which will be available for new construction of roads will be less than in 1926 but funds available for maintenance will be more owing to the increased revenues from gasoline and license tags. Prices on all road building material have a tendency to stiffen at the present time and it is believed that a better average price will be maintained throughout the year.

E. J. Krause (St. Louis, Mo.)

The central and southern Illinois, central and western Tennessee territory shows a greatly improved spirit of cooperation among the producers in our district due no doubt to the contact we have through the National as well as the local associations. The outlook in central and southern Illinois for 1927 is bright. The road program will go forward on a larger basis than 1926. Agricultural limestone will doubtless move in larger volume than 1926 which promised to exceed 1925 but was held down by excessive rains during the season in which the demand was heaviest. I refer to agricultural limestone as Illinois uses approximately one quarter of the total consumption in the United States. There will be a large municipal construction program in St. Louis. There is, however, more acute competition with gravel in this territory.

F. C. Murphy (Chicago, Ill.)

During 1926, in the territory comprising the states of Illinois, Michigan and Indiana, and into which states the producers, who are members of the Mid-West Division of the National Crushed Stone Association, ship at least 90 per cent of their tonnage, the volume of business has been, according to reports received, nearly equal to that of 1925, but a definite decrease in price is shown amounting to from five to ten cents per ton.

In the state of Illinois, owing to a heavy curtailment of the state highway department's program, the tonnage of crushed stone used in road building was considerably less than in the years 1922, 1923, 1924 and 1925.

The prospect for business in 1927 is particularly good in the territory referred to in this report. The state of Illinois proposes to let 1,000 miles of road on the new $100,000,000 bond issue system, and as evidence that this proposal will be carried out there is being let today, January 17, at the state highway department, Springfield, approximately 150 miles. In and about Chicago plans for widening all main highways leading into the city from eighteen feet to thirty feet are in advance stages, and this work will be under construction this year, while Cook County has recently passed a bond issue for the expenditure of $15,000,000 for secondary county roads.

A conservative survey of the situation would indicate that 1927 should be a particularly good year for the stone industry, and there are also, at the present time, definite indications that the prices will go back to the level in effect during 1923 and 1924.

John Rice (Easton, Pa.)

As to business conditions, past, present and future, I report as follows:

Past—During 1926 in eastern Massachusetts, western New York and eastern Pennsylvania business was better than normal throughout the year. In southern New Jersey and Maryland we felt somewhat the influence and competition of gravel, and in Delaware of slag, although we do not believe the latter competition will be serious over any great length of time.

Present—We are still operating three plants, two in eastern Pennsylvania and one in Maryland, which is a rather unusual situation at this time of year, and ran rather late in the season at two other plants for deliveries to the Pennsylvania

highway department to accommodate their desire to stock up ¾ inch stone for early spring repairs.

Future—As far as I have information at so early a date in the year, the outlook is universally promising throughout the territories to which I have already referred. I understand New York state is contemplating a $300,000,000 bond issue, which gives promise of continued business for some time to come in the way of highway construction. The reports of general business conditions submitted by practically all industries at the meeting of the Atlantic States Shippers Advisory Board in Baltimore last Thursday, the thirteenth, indicated a general expectation of continued healthy business conditions, the majority showing slight increases, a few showing some recession. A summary of the combined reports of the railroad companies for the middle Atlantic States was most reassuring and emphasized the fact that there would be, so far as they could now forecast, no recession of business for the first half of the year. With this expectation of general business conditions, it is fair to assume that the railroad ballasting program will be at least equal to last year, which was unusually good, so far as our experience was concerned. On the whole I think we can rest assured that 1927 will prove quite a satisfactory business year.

W. R. Sanborn (Kankakee, Ill.)

Necessarily my report must be very much along the same lines as the reports of Colonel Chamberlain, Mr. Krause and Mr. Murphy being in practically that same territory. I believe Mr. Murphy omitted one important feature from his report which concerns the prospective output for the state of Illinois for the coming year. We have not, in many recent years, had any large addition to our production but we are to have a big new crushing plant in southern Illinois at a point near East St. Louis this coming year, and Mr. Murphy is to take charge of the activities. Inasmuch as this is a big plant, I feel it is a very important factor in Illinois. Our state highway department has resumed its activities and that always is a welcome feature for us.

W. L. Sporborg (Syracuse, N. Y.)

For the state of New York, the year 1926 was one where the producers generally experienced a slight increase in their volume of business, and so far as I know a satisfactory margin of profit on their activities. The unfavorable weather had the effect of increasing the cost of production but not materially lessening the total volume of their output.

The year 1927 appears to be one in which we may reasonably expect a reasonable increase in our volume of business, and we see no reason to expect any change in the price level. The transportation service has been, and presumably will continue to be, adequate—in fact, excellent, and we hope for an increase in our total tonnage and an increase in our margin of profit.

Jeffrey Wilson (Watsonville, Calif.)

Although our territory is rather large, we are most familiar with conditions in southern California so our report will cover that only. With only stern self repression have we deleted all comments on climate in this report.

In discussing the present and the future condition of the crushed stone and sand business in central California, we must look to a post-war building boom to supply a reason for our present over production. During this boom, construction of numerous rock, sand and gravel plants was begun, many of which were finished at the time when the volume of building and other forms of construction was decreasing. At the present time central California stone and gravel plants have a capacity of about 200 per cent of our normal requirements.

The year 1926 has been a fairly good year for crushed stone, although the market has been in an extremely unsettled condition. One contributing factor is the lack of funds for the California highway commission to finance new construction. The two cent gasoline tax now in effect is divided by law, half being apportioned to the counties and half to the state to be used only for reconstruction and maintenance of existing state highways. The proposition put before the voters to increase this gas tax one cent failed and we hope that the legislature now in session will do something to finance new highway construction.

The present outlook for 1927 is conservatively optimistic as far as volume of business is concerned, although the price received by the producer for his materials probably will be low. More care is going to be exercised in financing buildings and privately bonded enterprises, as material men are no longer content to have their bills paid in heavily discounted bonds instead of cash. Trade associations are becoming more active in an endeavor to impress upon their members the necessity for fair and stable prices.

We expect to see the efficient organizations make money, the average organizations to lose money and the organizations below average efficiently to go broke during 1927, because the volume of business will not be sufficient to keep every one busy. To sum up the situation in a few words—"1927 will reward the fighters."

W. F. Wise (San Antonio, Texas)

Conditions as regards stone producers in Texas and Oklahoma for the past year have been slightly below normal. The railroads, having enjoyed a good business have ordered more ballast. Building in our larger cities has been good but our friends, the gravel people, have been able to get most of it. Owing to rather unfavorable political conditions at

Austin, the road business in Texas has been poor. Slight movement is noticeable in agricultural lime.

The crushed stone tonnage of Texas, of all other than railroad owned quarries, is about 95 per cent represented in this Association. In Oklahoma we only have two member firms. We have had enough labor at all times except during sixty days cotton picking time when our operations were restricted. Several of our plants have been electrified and enlarged this year. Car service has been very good.

The southwest Division of the National Stone Producers has been organized and held five meetings. Our engineering manager has been able to help our general standing. Our producers feel better toward each other. We anticipate for 1927 a slight increase in railroad business due to a rather extensive building program; considerable increase in road building and some increase in both building and agricultural lime.

Our labor conditions should remain the same as last year unless relations with Mexico should cause the Mexican labor to become restless. Railroad service should remain good. The engineers in our district will feel more kindly toward our product. Our need is more research work to prove the superior quality of the finished product made with crushed aggregate, better quarry supervision, more modern methods and equipment and better salesmanship in our own firms, backed by a better prepared product to sell.

P. A. Schroeder (Minnesota)

Minnesota district conditions were not up to normal as a whole in 1926. The demand for aggregate was far below normal which seems to have a tendency to make prices considerably lower than previous years.

At the present time it appears as though 1927 will improve conditions. Minnesota is contemplating a $40,000,000 bond issue for good roads and even though the state doesn't carry out this program, most of the counties will do considerable paving and it appears as though commercial building is coming back to normal. This, together with the state program, should make a much larger tonnage and tend to stabilize prices. It seems as though we reached our low point in 1926 and we will have a much improved condition in 1927.

M. B. Garber (Orrville, Ohio)

This is the fifth anniversary of the Manufacturers' Division of the National Crushed Stone Association. It was founded in Chicago in 1922 by about a dozen manufacturers' representatives, gathered together by Mr. N. S. Greensfelder of the Hercules Powder Company, the first and able chairman for two years, at the invitation of Mr. Scott Eames, president of the Association that year. The associate members now number eighty firms. Fifty of these firms are represented in this, the fourth exhibition, which is the largest not only as to the number of exhibitors, but by far the largest as regards the amount of floor space occupied and the revenue produced.

Nineteen hundred and twenty-six has been somewhat of a traditional year for the Manufacturers' Division. Instead of being a separate group, working along independent lines as in former years, it has been welded into the parent Association in order to facilitate the accomplishment of one common end, and that the promotion of the crushed stone industry. This has been done in such a manner that the identity of neither the active body nor the associate body has diminished. One secretary serves both groups and there is a common treasury. The Manufacturers' Division have their own chairman and directors. They are also honored with three representatives on the Board of Directors of the Association, one of whom is the chairman of the Division.

At the annual pre-convention dinner in New York in 1925, the manufacturers voted to suggest to the parent Association that their dues be increased from $50 per year to $100 per year in order to show their willingness to do their part in the meeting of a very much larger budget that was necessitated by the establishing of the Bureau of Engineering. This increase in annual dues may have been in itself a test of the value of the Association to individual firms, and the fact that there are more associate members now than a year ago seems to prove that the associate membership is on a sounder basis than before. Furthermore, the revenue produced thereby, which has been more than doubled, has been of very material assistance to the Association in the financing of their new program.

The annual pre-convention dinner of the Manufacturers' Division at the Hotel Commodore, New York, October 15, 1926, at which plans for the present convention were discussed, was attended by fifty-one representatives of associate member firms, and the Executive Committee of the National Crushed Stone Association. This was the most largely attended pre-convention dinner ever held and proved that interest and enthusiasm in the Association is increasing.

Last year during the convention at Montreal, the Manufacturers' Division presented resolutions to the Board of Directors of the National Crushed Stone Association which in brief suggested that the next convention be held at a centrally located city, that the active members be encouraged to bring their operating men and superintendents to the convention, and that special arrangements on the program should be made for these operating men. It is indeed gratifying that these suggestions met with such approval and it is, further evidence of the spirit of cooperation that has always prevailed in this Association.

A pleasant surprise was presented at luncheon on Monday in the introduction of John N. Vander Vries, Manager, Northern Central Division, United States Chamber of Commerce, and President, Chicago Rotary Club, who talked informally with the subject 'What Is It All About?" While we still do not know what it was all about, nevertheless we enjoyed listening to a very inspirational talk.

A. T. Goldbeck, Director of the Engineering Bureau, appared first on the program Monday afternoon with a paper entitled "Where Progress Lies in the Crushed Stone Industry" in which he touched upon practically all of the principal uses of crushed stone. This paper appears in full elsewhere in this issue and is worth careful reading. William E. Stanley, a sanitary hydraulic engineer, followed Mr. Goldbeck with a paper entitled "Crushed Stone for Sewage Disposal and Water Purification." This subject proved to be of considerable interest to a large number. This paper also appears elsewhere in this issue.

C. N. Connor, Chairman Low Cost Improved Road Investigation, Highway Research Board, National Research Council, presented the first of the papers concerning road construction on Monday afternoon with the subject "The Use of Crushed Stone in Intermediate Type of Road Construction." Mr. Connor discussed a flexible type road which is a surface lower in type, cost and traffic capacity than portland cement concrete and concrete base with asphaltic top, but higher than untreated sand, clays and gravels. While this paper will appear in full in the next issue of PIT and QUARRY some of the statements made by Mr. Connor can be quoted here.

"In the past much of the progress on low cost improved roads has been the direct result of necessity rather than of correlated effort, design and controlled experimentation. Within the last few years motor transportation has increased by leaps and bounds and traffic surveys have shown a steep upward trend in registration, with no indication that the saturation point has been reached, or that the curve will break downward. Engineers and others are now realizing that this traffic must be served and that it is sound economy to give road service at once. They are therefore cooperating with industry to solve this problem of general road service. The problem has been and can be met in many instances by comparatively low cost improvement of existing roads and by the intelligent use of local materials combined with shipped in binders and admixtures.

"In order to fully realize the magnitude of the possibilities in intermediate or low cost road construction, let us consider for a moment the road mileage of the United States in the light of the last published figures. Those given by Mr. Thomas MacDonald in 1926,—the total mileage of the country was in 1924 about 3,000,000 and the total surfaced mileage including types as low as sand clay was about 468,000, leaving as a difference of unsurfaced roads something over 2,500,000 miles. Let us leave this 2,500,000 miles for the minute and investigate by analysis the 468,000 surfaced miles; we find approximately 308,000 miles are surfaced with nothing better than untreated sand clay and gravel; 105,000 with water bound macadam, surface treated macadams and gravel, and bituminous macadam; leaving only 55,000 miles of the higher and miscellaneous types.

"Analyzing Mr. MacDonald's figures still further, in order to determine the road mileage which may be improved from the low or partially inadequate surfaces to the intermediate type, we find sand clays 63,681 miles, untreated gravel 244,282 miles and water bound macadam 60,234 miles, making a total of 368,197 miles or nearly 80 per cent of the total surfaced mileage in the country. We have therefore 368,000 miles of highways a large portion of which, in its present condition, is suitable for only 500 to 700 vehicles per day. The use of local materials has properly played a large part in the construction of practically all of these low type surfaces.

"The reasons for improving this large mileage, are of course, to increase traffic capacity, to make them serviceable at all seasons of the year, to furnish smoother riding surfaces, to prevent loss of surfacing material, to reduce the dust nuisance and to increase their safety. More and more we are realizing the value of progressive or stage construction, which means building upon a suitable subgrade, a subbase and surface which will carry traffic for a time at least and which will later be very valuable as a base course for an added, new surfacing of more substantial material.

"There is a need for the construction of a low type surfacing on a tremendous mileage of unsurfaced roads in order to develop isolated sections and furnish feeders to the trunk highways. There is immediate need of surface improvement on a large mileage of existing low type surfacing whose present traffic capacity is probably not over 700 vehicles per day. The intermediate type road is a step in stage or progressive road construction. The first stage after grading is to give road service on a base course of good, local, short haul material. These materials may be sand clay, gravel, lime rock, shale, caliche, waste industrial products or whatever the locality can furnish cheaply. In this class we find an immense mileage of existing roads whose traffic capacity is limited, as stated before to 600 to 700 vehicles per day.

"The cost of these bases or surfaces is generally well known by the local engineers, and will vary with local conditions from $3,000 or less to possibly $10,000 per mile. The next stage is the surfacing of the existing base with a better surface. This can be done by utilizing various materials.

Probably the best are those which include crushed stone as an aggregate, they are:

Skin surface treatments.
Mixed in place surfaces.
Bituminous macadam.
Bituminous concrete, black base and
Sheet asphalt binder.

"The traffic capacities for these surfaces will range from approximately 1500 to 7000 and possibly more vehicles per day. The first cost will range from about $2,000 to $15,000 per mile for an eighteen foot width. The yearly maintenance cost of such surfaces will range from about $1,200 to $2,000 per mile per year. Those having a higher first rate are usually lower in maintenance costs when serving within their traffic capacities."

The sessions on Tuesday morning were started by A. C. Avril, Mining Engineer, France Stone Company, by a discussion of the problems involved in the installation of the France Stone Company laboratory. Mr. Avril told something of the history of the laboratory, its purpose and program. The purpose of the laboratory was stated as follows:

"Regarding the purpose of the laboratory, we can just about sum it up in a few words by stating that our laboratory was installed to enable us to make a systematic investigation of the problems of the industry. We are doing systematic prospecting on all of our quarries. We are core drilling all of them in a way that we will be in a position to know at all times what the quality of stone is that we are quarrying. The quarries are plotted and core drilled in regular locations and from these maps we can determine from year to year just where we are and what the prospects for stone are.

"In conjunction with this we will make the necessary tests on the stone for physical and chemical properties. We do not take the entire core as one sample but divide it up into sections noting as close as possible where the changes in the face occur so that we can obtain as close to an accurate average as possible. Aside from this, another purpose of a laboratory is to check up on materials that we purchase for use in our operation, such as coal, oil, gas, babbitt metal and things that you would naturally buy on an analysis specification.

"It is only natural that we should conduct some research work in conjunction with our regular testing to determine the quality of the stone. We have outlined somewhat of a program to follow in the work that we are doing. We are conducting physical and chemical tests and hope to follow up with a microscopic analysis of all the stone in our quarries. We are checking materials that we buy for use in the industry and we are also conducting some research work. At present it seems the most important problem we have confronting us in the question of what stone will do in concrete if properly sized, properly mixed, and if the proper care is taken in the construction as a whole. We are dealing with this problem particularly from the angle of using stone screenings with the dust in and without the dust as a fine aggregate. Our aim is to promote a concrete whose aggregates both fine and coarse are crushed stone. So far all the work we have done on that is in connection with concrete block construction, because that problem presented itself this last year in Toledo.

"Another problem that is of great importance to us is to know whether or not our stone will resist actual freezing and thawing well enough so that we can put it on any kind of a job, filter bed work and progressive maintenance road construction, and so forth, where the weathering of stone is rather a large item. In this work we have installed a piece of equipment whereby we can actually freeze and thaw stuff with ice to see whether it will stand up under the actual conditions. We intend to get reports from the weather bureau and try to establish an average number of freezings and thawings that actually occur throughout the year and in that way hope to be able to interpret how long our stone will last when exposed to the elements. This work has not been begun yet but we hope to start on it sometime soon."

Col. Sidney D. Waldon, Chairman, Detroit Rapid Transit Commission, presented a very interesting paper on the super highway and its past in Detroit's master plan. The speaker used lantern slides and moving pictures at the end of his remarks to illustrate the old and new highway situation in and around Detroit. The master plan covers Wayne, Macomb and Oakland counties. Mr. Waldon's explanation of how municipal surgery can be reduced to a minimum in the future by the adoption of a master plan was quite enlightening.

Bituminous road construction was discussed by R. W. Coburn, Construction Engineer, Department of Public Works, Boston, Mass. Before going into the details of construction Mr. Coburn reviewed briefly the history of bituminous macadam roads. He defined this type of road by quoting the definition adopted by the Association for Standardizing Paving Specifications as follows: "Bituminous macadam pavements are those consisting of broken stone and bituminous materials incorporated together by penetration methods." The materials used in the construction of the Massachusetts standard type, the machinery and equipment necessary, inspection and methods of carrying on the work were discussed in detail. This paper will be published in the next issue of PIT and QUARRY.

Some modern developments in bituminous road construction and maintenance was the subject of a paper by K. E. McConnaughay of the Hayes Construction Company of Indianapolis. Conditions in Indiana are somewhat different than in Massachusetts, particularly in the matter of stone which is a softer material in Indiana. The retread type and

black base were discussed in detail. This paper will also be published in the next issue of PIT and QUARRY. George E. Martin, Consulting Engineer, the Barrett Company, commented on both Mr. Coburn's and Mr. McConnaughay's papers. G. H. Henderson, Chief Engineer, State Board of Public Roads, Rhode Island, had the subject "Bituminous Macadam Construction" but because Mr. Coburn had gone so thoroughly into the same subject, Mr. Henderson did not read his paper. He rather stressed in informal discussion some of the points previously brought out.

Agstone Luncheon

One of the most interesting luncheon groups was that sponsored by the National Agstone Association which met on Tuesday and Wednesday. L. E. Poorman, President National Agstone Association, presided. Officers for 1927 were elected and include L. E. Poorman, president, W. H. Margraf, secretary-treasurer and F. J. Colgan, vice president.

J. R. Bent, Director, Farm Supply Department, Illinois Agricultural Association, presented a most illuminating paper entitled "Marketing Agstone in Illinois." This paper will appear in the next issue of PIT and QUARRY, but a few remarks of Mr. Bent will be quoted here.

"Right here let me say that I feel that the farmers as a class should not be held responsible for a fault which is national in character. The conditions which surround agriculture today are the product of a complicated industrial and commercial system in which agriculture is out of joint. While it is true that the extravagant and wasteful manner of handling the soil in our agricultural system is a national problem which needs a national solution, it is also true that the individual farmer can receive a commensurate reward if he adopts crop rotation methods suitable to his territory and applies, correctly, soil building and maintaining materials. At the University of Illinois are some field plots where careful experiments have been carried on for a long period of years. As an example, based upon average values and practical farm conditions, on plots where corn has been grown continuously, without crop rotation or soil treatment, the cost of production per bushel has risen to ninety-three cents. On plots where a rotation has been used, including clover, the cost to produce corn per bushel has been held to fifty-two cents, and on plots where the crops have been rotated and manure, limestone and rock phosphate have been added, the cost of corn has been reduced to forty-three cents per bushel, and these last figures include the cost of treatment. Limestone in southern Illinois applied at the rate of two tons each four years on a test field doubled the yield per acre. The value of the increase in the four year period nearly equalled the original purchase price of the land.

"Quickly available material, whether in the form of burnt lime, hydrated lime, air slaked lime or finely ground limestone, irrespective of its cost, would be inexpedient and uneconomic if applied in large quantities per acre. There would be what the chemist knows as mass action. In other words, the limestone would dominate the soil plant food balance and would interfere with, or inhibit, the availability of some of the other necessary plant foods, such as the phosphorus salts and perhaps the potash salts. There would be over-stimulation or liberation of some of the organic plant food elements and there would be heavy loss through leaching of these organic elements and of the lime itself. Logically, therefore, if highly available material is used the extreme theoretical ideal would be absurdly frequent applications in very small amounts.

"Three tons per acre of limestone screenings costing, freight included, perhaps two dollars per ton or six dollars per acre and containing as an average proposition perhaps 20 to 22 per cent or 1200 to 1400 pounds of material 80 mesh and finer, would be the equivalent in early availability of perhaps one and a half to one and three-quarters tons of more finely ground limestone containing approximately the same amount in pounds of 80 mash and finer material and costing nearly as much. The former material would have the advantage of having graded sizes of coarser material still left in the soil to gradually yield through a longer period of time as a maintenance ration.

"There is a great need for open-mindedness and flexibility in our specification policies in order that we may judge each case by itself and fit the conditions together in the most economic way. You, as a group, interested in limestone production problems are familiar with the production costs in the quarry and in the crushing and sizing plant, but are not so familiar with the scientific agricultural facts or with practical farm needs and technique.

"To summarize I would suggest that the following are the conditions upon which must rest the chances for the greatest development in the use of limestone on the soil:

"1. Specifications established and varied from time to time in the light of intelligent knowledge of the economic conditions which currently prevail in the quarry industry and in the agricultural industry.

"2. Efficient and adequate production at the quarries.

"3. Reasonable profit to the limestone producer in order to keep up his interest and stimulate him to maintain quality and service as well as adequacy of supply.

"4. Stability of price upon a basis fair to both the producer and the purchaser.

"5. The promotion of the simplest, most direct, and most efficient system of sales and distribution.

"6. Encouragingly low freight rates which can be justified from the railroads' standpoint by consideration of the selfish advantage to the railroads of agricultural productivity and rural thrift.

"7. Close working accord between all groups, including producers, users, scientific research men, agricultural educators, etc.

"8. The realization by the farmer of the price basis and conditions under which he can with profit and fairness both to himself and the producer make full use of this material.

"9. The farmers' financial status or ability to buy freely."

Herbert F. Kriege, formerly in charge of the research work of the National Agstone Association and now with the France Stone Company presented a paper entitled "Relation of Fineness of Agstone to Its Rate of Solubility." This paper will be published in the next issue of PIT and QUARRY so we will state here only the results of Mr. Kriege's study and experiments on this subject.

"In general, the results obtained under field and laboratory conditions in this investigation support the original assumption that the rate of solution of limestone particles is inversely related to their diameters. The rate of solution of limestone in acid media is specific for that limestone.

"The physical properties, such as crystallinity and hardness, do not indicate the specific solution rate of a limestone. The rate of solution of limestone is affected greatly by its composition, especially by its content of magnesium carbonate. In general, the higher this content the lower the solution rate, but not in direct proportion to the $MgCO_3$ content. Certain exceptions to this general statement were found. One dolomitic limestone containing 23 per cent $MgCO_3$ was found to dissolve more rapidly during the first half of its solution than did practically pure calcite and other limestones of high calcium content.

"In this investigation the dolomitic limestones observed were shown to be mixtures of the double carbonate of lime and magnesia ($MgCO_3$. $CaCO_3$) and $CaCO_3$. As the solution of the more quickly soluble $CaCO_3$ takes place the residue becomes enriched in its $MgCO_3$ content. Under the microscope the residues from the partial solution of dolomitic limestones were found to consist largely of well defined crystals, showing little solution effects. The index of refraction of these almost unaltered crystals was found to be 1.68 corresponding to dolomite.

"The dolomitic limestones were observed to disintegrate in dilute acids into smaller particles, thus offering new surfaces to solution. As a result, the rate of solution of the larger particles of such limestones was somewhat greater than was to be expected from their size. In the soil this disintegration during solution was not observed. The compacting of soil particles about the limestone particle would tend to prevent disintegration.

"Fineness of division is more important to magnesian limestone than to those of high calcium content for purposes of correcting soil acidity quickly, because of the slower solubility of the magnesian material. Greater leaching losses occur from applications of high calcium limestones than from those of high magnesium content.

"The time required for the complete disappearance of a 48-65 mash particle of high calcium limestone under these conditions was approximately two years. The time required for the high calcium composites to neutralize one-half the limestone requirement under these conditions was between eighteen months and two years. These applications had been made on the basis of the neutralizing effect of the 48-65 mesh particles. Hence, the rates at which these composites became available are in agreement with the calculated values.

"The effects of the high calcium limestones separates under the same conditions vary from 42 per cent in the 4-6 mesh material up to the desired value in the material finer than 48 mesh in two years. The effect at the end of two years of 48-65 mesh high calcium limestone applied to satisfy the full limestone requirement is four times as great as that of the same material applied to satisfy only one-fourth the total requirement. Under the same conditions a full application of 48-65 high magnesium limestone satisfies only three times as great a requirement as does a one-fourth application.

"The full application of 48-65 mesh high calcium material showed 80 per cent efficiency at the end of two years while high magnesium limestone showed 40 per cent. At the end of three and one-half years, however, the high calcium efficiency fell to 66 per cent while that of high magnesium stone rose to the same value and continued to increase. On farm plots with different soil types different responses are noted to the same limestone applications. The results which have been presented from small plot, pot, and laboratory studies show that the rate at which limestone becomes available in the soil can be predicted with fair accuracy from a knowledge of the screen analysis of the material used."

Fred L. Petty, National Farm Radio Council, discussed the advantages of broadcasting agricultural information to the farmer. He first explained that the National Farm Radio Council represented many agricultural groups and organizations with a message for farmers which it was decided could be put across over the air. The results have justified the undertaking. He urged that the agstone producer give consideration to radio as an added means of getting a message to the farmer.

Salesmen Luncheon

Harry Brandon presided over a luncheon held especially for salesmen and a real instructive paper

on "Market Analysis" was presented by Arthur Livingstone, of McKinney, Marsh and Cushing. The value of a market analysis, its preparation and use were clearly presented. This paper will be pumlished in an early issue of PIT and QUARRY.

Operating Men's Luncheon

More than 150 attended a luncheon for superintendents sponsored by the Manufacturers Division and presided over by M. B. Garber. Subjects of accident prevention, safety work, fires, fire drills and physical examination of employees were brought up for discussion. Several superintendents took part in the discussions. N. S. Greensfelder pointed out that the cement quarries had a lower accident rate than crushed stone quarries because of the effective safety work carried on over a long period of time. While the compensation laws of states differ it was generally agreed that employees should be examined before employment to reduce the danger of having to pay compensation for an injury that probably resulted because of some physical conditions which existed before employment.

Winter Storage of Stone

W. R. Sanborn presented the report of the committee on winter storage of stone. The question concerned the desirability of winter operation and storage. The favorable and unfavorable factors from the standpoint of the quarryman, contractor and engineer were presented. The following is an outline of Mr. Sanborn's report:

I. Desirability of Winter Operation

Quarryman's Viewpoint.
- Favorable Factors:
  - Quarries are idle too long in the winter season.
  - Winter operation would give greater annual output.
  - Winter supply cannot be made during the busiest season of summer.
  - Will reduce overhead cost per ton.
  - Will cut cost at the end of the season.
  - Take better care of customers.
  - Gives a service which gravel pits cannot duplicate.
  - Creates work and better satisfaction for the quarry labor.
- Unfavorable Factors:
  - Cost of plant storage and recovery.
  - Increased cost of winter operation.
  - Danger of overproduction and consequent price reduction.
  - Possibility of storing undesirable sizes which will never be reclaimed.
  - Apathy on part of consumer.
  - Some time required for plant repairs.

Contractor's Viewpoint.
- Favorable Factors:
  - Supplies material required by increased winter activity.
  - Insures adequate supply whenever required.
  - Avoids idle time resulting from quarry delays.
  - Requires less equipment in busy season.
  - Cannot do winter work without material.
- Unfavorable Factors:
  - May require additional equipment.
  - Cost of job storage and recovery may be prohibitive.
  - Cost of plant storage may be objectionable.
  - Requires considerable area.
  - Contractor may not be awarded contract soon enough.
  - It is undesirable to add to his many operating details.
  - There is a tendency for various sizes to segregate in the pile.
  - Runs a chance of storing undesirable sizes.

Associates' Viewpoint.
- Favorable Factors:
  - Desire for continuous winter operation.
  - Reduction of summer peak loads.
  - Constant outlet for their product.
- Unfavorable Factors:
  - Storage must be financed.
  - May require special legislation.
  - Highway Departments may contemplate change in sizes.
  - Storage process must be policed to insure proper product when used and to avoid contamination or segregation of the product.

II. Problems Involved

Quarryman's Viewpoint.
- Internal Problems:
  - Difficulty of operating in very cold weather.
  - A few impossible days.
  - Capital expense required for storage equipment.
  - Operating cost of storage and recovery.
  - Great area required for any considerable amount or variety of sizes.
  - Need of time for winter repairs.
  - Problem of financing the cost of material while it is in storage.
- External Problems:
  - To properly allocate added costs.
  - Determination of proper sizes to be stored.
  - To get the contractor to store at destination.
  - To secure cooperation of engineer in solving the contractor's problems.

Contractor's Viewpoint.
- Internal Problems:
  - Using all his available space at his setup for storage.
  - Financing cost of storage.
  - Operating a storage pile when all other branches of his work are laid up for the winter.

Extra handling of the material.
Keeping the stone clean until used.
Dividing his equipment and personnel for starting the storage pile.
Many months before doing the actual work of construction.

External Problems:
Difficulty of getting the owner to pay for stone carried in storage.
Legislation needed to secure estimates on stored material.
Contracts not let early enough to make storage possible.
Piling to suit the engineer in charge.
Securing permit from the railroad to occupy the necessary ground.
Cost of idle time between intermittent shipments during the winter.

Associates' Viewpoint.
The problem of Associates seems to be principally that of harmonizing or making possible the solution of the problems listed above.

III. Possible Solution of Problems

Quarryman's Viewpoint.
Easy labor in the winter and reduced overhead should help to carry a considerable part of the extra cost due to winter operation and a considerable part of storage cost.
It is not necessary to operate six days per week in winter, which enables the quarry to shut down on any particularly unfavorable days.
As the material is not washed or handled with water, temperature is not a very great factor.
In general it may be said that quarryman is able to solve all of his internal problems.
It is possible to use equipment for storage that is not otherwise used in the winter.
The quarry might well carry the cost of stone while in storage if the contractor can arrange to carry the cost of freight and unloading.
The adoption of standard sizes would go a long way towards simplifying the general problem.

Contractor's Viewpoint.
Longer time to pay for stored material should be an incentive.
Arranging with the owner to pay for stone in storage would help.
Winter storage would create a soft job for men on the pay roll all the year round and no particular occupation during the winter months.
The railroad could well afford to supply the necessary space as an offset to congested car demand during the busy season.

Associates' Viewpoint.
Here again the Associates are in a position to assist in the solution of the various problems which are not factors of quarry operation.

The Wednesday morning sessions proved to be of surprising interest. W. M. Weigel, Mineral Technologist, Missouri Pacific Railroad, presented a complete paper on "Stone Dust, Its Use and Preparation." While this paper will be published in the next issue of PIT and QUARRY several extracts will be of interest here.

"Rock dust may be obtained from limestone, marble, slate, sandstone or the silicate rocks, but that obtained from limestone and marble constitutes by far the greatest amount as it has wider distribution and more commercial uses than any of the others. Slate dust, pulverized slate or slate flour is used to some extent as a filler for asphalt pavements, in plastic cements, various moulded articles of manufacture and has been tried in linoleum and rubber. While used to some extent in these two latter materials, it has not proved as satisfactory as hoped for. Its production is limited to certain restricted areas, so is handicapped for general use as a substitute for other materials. Red slate flour is sometimes used as the pigment in paint for the burlap backing of linoleum.

"The silicate rocks, such as granite and trap rock, would never be used primarily as a source of rock dust. In the preparation of commercial sizes, however, a certain amount of fines are unavoidably produced and constitute a by-product for which the quarryman desires to find a market. Due to its physical and chemical properties, it has little or no fertilizer value and cannot be used for mine dusting. Also, mainly due to its physical properties, there is little hope of its finding application in the field of high grade fillers, so silicate screenings are more or less restricted to structural uses as fine aggregate to replace sand. If ground sufficiently fine, they may find some outlet for abrasive purposes.

"Limestone and marble dust may be divided into two general classes; first, comparatively coarse material including agricultural limestone, dust for mine dusting, asphalt filler, and as a stock food ingredient; second, extremely fine ground products used mostly as a filler in various manufactured articles. The quantity produced of the first class greatly exceeds that of the second, but the price is much less, for restrictions as to fineness, color and chemical purity are not so hard to meet and the market is much greater. For most purposes marble dust may be used the same as limestone dust.

"Methods of preparation of stone dust are of as much interest to the producer as the various commercial uses of the product. Equipment is selected which will produce the desired grade at the least cost, all things considered. This requires considerable investigation as some manufacturers are prone to recommend their machines for any kind of service. In installing new equipment the operator

will usually be guided by the experience of others producing a similar product from the same kind of raw material. Equipment which would be suitable for pulverizing agricultural limestone obviously would not do to make high grade whiting, and a machine suitable for the latter would not be efficient on agricultural limestone.

"The stone producer who considers entering the stone dust field for any reason has a problem to consider from a great many angles. He may have a waste product on hand which quarrying and crushing costs have already been written off. The question then is, can he put this into such shape that it can be marketed at a profit. Available markets are of first importance. This includes not only the quality of material for which a market exists, but their location with respect to competition from other sources and distances from the producing plant. If markets can be reached, a study of his raw material must be made to see if it meets the particular requirements. Then must follow an estimate of the cost of the plant and cost of operation, which, of course, is controlled by the capacity, and quality of the material which it is proposed to produce."

G. F. Schlessinger, Director of Highways and Public Works for Ohio, discussed the "Value of a Transport Survey." The question was approached from the angle of whether or not the highway transport survey is worth the money it costs. Ohio completed the fild work on a comprehensive survey about a year ago so Mr. Schlessinger was in a position to discuss his subject with first hand knowledge. The cost of the Ohio survey was $150,000 and the data secured included

(a) The number and type of vehicles.
(b) The rated capacity and gross, axle and wheel loads of motor truck.
(c) Principal commodities transported by motor truck.
(d) Towns of origin and destination of passenger cars and motor trucks.
(e) Type of usage of passenger cars.
(f) The number of out-of-state vehicles.

Concerning the value of the transport survey Mr. Schlessinger said: "If both the state and federal highway department had not believed that this survey would pay good dividends on the investment, they would not have undertaken the project. A transport survey per se is not the sine qua non of successful highway administration. The states that now have a transport survey cannot assume a "holier than thou" attitude in the belief that their highway problems of the future have been solved. The value of a transport survey is dependent entirely on whether it is used.

"The highway transport can be valuable in many ways and particularly in the following:

(1) In forecasting future traffic.
(2) For the proper location of a highway system.
(3) For the classification of highways.
(4) To provide a measure of highway costs, construction and maintenance.
(5) To analyze traffic requirements.
(6) In planning a highway improvement program and budget.
(7) In the organization of highway department personnel.
(8) In traffic control problems and regulations.
(9) As a guide to proper highway legislation and methods of finance.
(10) To assist in the economic coordination of all systems of transportation—rail, water and highway."

W. D. M. Allen, Portland Cement Association, outlined in a general way the uses of crushed stone in the manufacture of concrete products.

F. H. Jackson, Engineer of Tests, U. S. Bureau of Public Roads, discussed "Commercial Crushed Stone" and it was interesting to note that the sizes recommended checked very closely with those adopted for the State of Ohio. The following extracts from Mr. Jackson's remarks are interesting:

"Practically every one having to do with either the production or the utilization of crushed stone will concede at least the theoretical advantages which may be derived from the standardization of sizes. The wide divergence of existing standards of construction, however, coupled with a natural reluctance on the part of engineers to change their practice simply to comply with a national standard, has made progress in this field very slow. We all know of course how the unsystematic development of the various types of bituminous macadam and bituminous constructed roads has resulted in a demand for a great number of sizes of stone, for a comparatively small number of distinct types of construction, the variations often being of academic rather than practical significance.

"We may classify these variations in requirements in two ways, first those due to distinct differences in engineering practice for a given type of construction and second, those very small differences in requirements which are in reality meaningless, but which frequently cause lots of trouble. As an illustration of the first class, a survey of twenty-seven current state specifications for penetration bituminous macadam reveal that there are now specified as many as ten different sizes of stone for use in the penetration course alone, varying all the way from a 1 to 2 inch size to a 2½ to 3½ inch size. As an illustration of the second class, we may take the requirements for size of chips for bituminous macadam, where a current specifications show an inexcusable number of slight varia-

tions in size, as for instance, $\frac{3}{16}$ to $\frac{5}{16}$ inch, ¼ to ½ inch, $\frac{5}{16}$ to ½ inch, etc.

"Making every allowance for variations in size necessitated by difference in quality, it is yet obvious that the multiplicity of requirements in force is not only unnecessary and confusing but also works a hardship on the producer, increases the cost of production, and so tends to ultimately increase prices. On the other hand, we must remember that it is the engineer in charge of construction and not the producer of the material who is responsible for the quality of the work and for this reason we cannot expect him to abandon a size with which he has perhaps had many years satisfactory experience unless we can convince him that the standard size will prove just as satisfactory. And herein lies our greatest difficulty. It is not, I believe, as much with the producers as with the engineers. My experience with the producers in general is that they are more than willing to supply what the engineers want, provided the latter will only agree as to just what they do want.

"Before proceeding to a discussion of the proposed standard, it may be of interest to review very briefly the results secured from a rather extensive survey of crushed stone plants made by the Bureau of Public Roads several years ago. The survey included over 100 representative commercial stone crushing plants situated in the New England, Middle Atlantic and Ohio Valley States. The information secured, while of course centering about the screening operation, included data relative to crushers, their number, type and size, speed and arrangement of conveyors, etc. The screen data included the number, type and arrangement of screens, the nominal as well as actual size of perforations, the length, diameter, pitch, and speed of revolving screens, together with the number and length of each section, arrangement of jackets, etc. A record was also made of each commercial size produced by the plant with the screen installation as indicated at the time of inspection. This record included the nominal size limits for each product, the name and number under which it was sold, the specifications it was supposed to meet, etc. Finally a representative sample of each size was secured from a stock ready for delivery and a screen analysis made with laboratory screens using circular openings.

"From the data secured as outlined above, it was possible to determine directly the efficiency of each screening operation at the time of inspection in so far as it was affected by the screens themselves. Other factors which affect screening efficiency, such as fluctuations of the feeding rate, and moisture on the stone were noted and their effect on the particular material selected for sampling determined as nearly as possible. It may be of interest to briefly summarize the conclusions which it was possible to draw from this survey, and they may be stated as follows:

"1. The length of a revolving screen influences the grading of the screened product to a marked degree.

"2. Within the relatively narrow limits usually found in plant installation, pitch and speed of revolving screens have no practical influence on grading, probably on account of other predominating factors, such as fluctuations in the rate of feed of stone to the screen, which it is impossible, practically to control.

"3. The effect of oversize holes due to wear of the screen is practically negligible in view of the relatively large amount of stone held on a revolving screen which theoretically should have passed through it.

"4. Small amounts of oversize stone, sometimes found in products screened through holes of certain nominal diameter, usually are due to faulty bin or chute construction, lack of repair, or other deficiencies in the storing or handling of the material.

"5. The grading of the screened product can not be controlled with any degree of certainty by simply specifying the size of openings in the revolving screens over which and through which it shall pass.

"6. It is neither practical nor necessary to specify that all material retained on and passing revolving screens of certain sizes shall lie between laboratory screens of the same size.

"7. By the insertion of a reasonable tolerance, that is, one wide enough to cover the recognized inefficiency of the revolving screen, and yet close enough to insure sufficiently well graded materials, the laboratory screen may be used logically to control the grading of the plant product.

"8. Inspection of the results of hundreds of screen analyses indicate that as much as five per cent material should be allowed larger than the size of perforations in the revolving screen through which the product is supposed to pass, and as much as fifteen per cent generally should be allowed smaller than the size of the perforations in the revolving screen upon which it is supposed to be retained. The last conclusion applies of course only in the case of products sized with revolving screens and presupposes an adequately designed plant and efficient operation. It applies also to the so-called primary sizes only, that is, those sizes where the upper and lower limit are close together; say ¾ to 1¼ inches. On combined sizes, such as are used as concrete aggregate, ¼ to 2½ inches, for example, the tolerance on the lower limit may and should be materially reduced.

"On the basis of five primary sizes as the maximum limit and after carefully studying existing specifications, the Committee proposed the following divisions of the crusher run from 0 to 3½ inches:

0 — ¼	¾—1¼
¼— ¾	1¼—2½
	2¼—3½

the separations to be on the basis of laboratory screens with round openings. Assuming, in general, that stone will crush in such a way that the percentage of the total crusher run passing any particular size screen will be proportioned to the size of the opening—that is, conforming to what is known as a straight line grading, then the relative percentages of the total crusher run obtained in each of the five primary sizes would be about as follows:

0 — ¼—10% ¾—1¼—15%
½— ¾—15% 1¼—2½—35%
2½—3½—25%"

The sessions on Thursday were particularly interesting. Four excellent papers were presented and two of these appear elsewhere in this issue. "Earth Vibrations Caused by Quarry Blasting and Their Effects on Structures" by Edward H. Rockwell appears elsewhere in this issue. "Transportation Preparedness" by W. J. McGarry also appears elsewhere in this issue.

Harold Williams, Member of the Boston Bar, discussed quite thoroughly the legal aspects of quarry blasting in a paper entitled "Vibrations as a Practical Legal Problem in Quarry Operation." This paper will appear in a later issue of PIT and QUARRY. Generally speaking it would appear from Mr. Williams' remarks that a quarry operator cannot be held liable for damage resulting from blasting operations unless the operator has been negligent. The courts have the final say as to negligence and their findings will vary in different parts of the country. Damage resulting from vibration is a different legal problem from damage by blasting direct as the factors are less tangible. The legal definition for a nuisance enters into the problem. If licenses or permits to do blasting are required it is imperative that they be secured because failure to have such a permit is proof of negligence.

H. F. Clemmer, of the Solway Sales Corporation, presented a paper entitled 'Field Testing of Concrete for Concrete Roads." The importance of field tests in judging concrete roads was stressed. The importance of the aggregate information resulting from such tests and its usefulness to the producer as a check on specifications and service was brought out clearly.

The committee report on Welfare and Safety was presented at the Farewell Luncheon on Thursday by N. S. Greensfelder. Their report which is published here was discussed by E. E. Evans, the Whitehouse Stone Company, and D. C. Souder, of the France Stone Company.

Welfare and Safety

The Committee on Welfare and Safety was appointed by President Graves following the meeting of the Board of Directors in Atlantic City last summer. Its primary purpose is to promote organized effort throughout the entire crushed stone industry towards reducing the number of accidents at crushed stone quarries, and thereby diminishing the suffering caused to employees and their dependents, and the financial loss to the industry.

Statistics compiled by the United States Bureau of Mines from the data supplied by companies participating in the National Safety Competition showed that in 1925 the average accident severity rate at quarries operated by members of the National Crushed Stone Association was appreciably higher than the average for quarries producing stone used in the manufacture of cement.

It is the belief of some impartial judges with long experience in many industries that the more favorable showing in the cement plants is to a large extent the result of the organized accident prevention campaigns that have been conducted for years by the Portland Cement Association with the cooperation of all its members. The first meeting of the Committee on Welfare and Safety was held in New York City, October 15, 1926. This meeting was also attended by members of the Executive Committee of our Association and representatives of the United States Bureau of Mines. Definite recommendations were agreed upon as plans for procedure most desirable at this time, and it was voted to submit these to the membership at the annual convention for approval.

Committee's Recommendations

(1) That a complete, detailed statistical study be made and issued annually covering accidents from all causes throughout the industry in order to provide an intelligent basis for directing preventive measures.

(2) That a pamphlet on Standard Safety Practises in quarries be compiled and published, that will enable each member company to place in the hands of its employees helpful recommendations for the safe conduct of every day tasks.

(3) That a safety organization be perfected at each operating plant and that elected representatives of the employees cooperate with the appointed representatives of the management through a safety committee, for the safeguarding of life and property. The National Safety Council has offered to prepare an outline, on recommended methods for organizing safety committees, copies of this outline will be distributed to all members of the National Crushed Stone Association with the compliments of the National Safety Council.

The United States Bureau of Mines has offered to prepare each year a detailed statistical analysis for the entire industry at no cost to the Association. The only requirement is an obvious one, namely that all members of the Association shall furnish the Bureau with the necessary data on which to base its statistical studies. For this purpose a carbon copy of the monthly accident reports which all operators must furnish to their State Industrial Commissions will suffice.

The following official communication on this subject has been received by your committee from the United States Bureau of Mines:

"To the members of the National Crushed Stone Association in convention at Detroit: Quarry operators holding membership in the National Crushed Stone Association are cordially invited to participate, so far as they may be eligible, in the National Safety Competition covering the calendar year 1927. To the quarry that establishes the best safety record during the year will be awarded the bronze trophy 'Sentinels of Safety.' The relative standing of the contestants will be determined from accident reports furnished by the competing companies to the Bureau of Mines. At the close of the year each Company will be confidentially advised of its standing in the contest. As competition in accident prevention is undoubtedly one of the chief factors for promoting safety work, it is earnestly hoped that many of the members of the National Crushed Stone Association will find it to their interest to participate in this joint effort to make stone-quarrying a safer occupation and to lower production costs by eliminating accidents."

Safety Practises Pamphlet

A sub-committee consisting of D. C. Souder, France Stone Co., E. E. Evans, Whitehouse Stone Co., Oliver Bowles, United States Bureau of Mines and W. Dean Keefer, National Safety Council, was appointed to draft recommendations pertaining to the Safety Practises Pamphlet. This sub-committee reported as follows:

"The National Crushed Stone Association in collaboration with the National Safety Council—and the United States Bureau of Mines should issue a pamphlet entitled 'Standard Practises on Safety in Quarries.' This would not be what is known as a 'code' but would outline the safety ideas of these organizations and would not conflict with any laws relative to safeguarding machinery as adopted by various states in the Union.

"The Association's pamphlet could be divided into parts or subjects as follows:

"Section 1—Blasting: Safety practises in the use and handling of explosives and in drilling operations.

"Section 2—Transportation: Safety practises in the loading, unloading and transporting of material at quarries including stripping, storage and reclaiming operations.

"Section 3—Mill Operations: Safety practises in the crushing, screening, and all other operations in the mill or plant.

"If it was decided to go further, another section pertaining to child labor, sanitation, could be added."

At the invitation of your Committee, the Institute of Makers of Explosives has already submitted recommendations on safety practises in the storage, transportation and use of explosives in quarries.

First-Aid Training

The United States Bureau of Mines has also been approached on the matter of giving first-aid training to employees at crushed stone quarries. The Bureau, through the chief engineer of its Mine Safety Service has expressed, not only a willingness, but a desire to do this. A letter has been prepared by your Welfare and Safety Committee and submitted to your Association's headquarters at Washington requesting members to say whether they are interested in arranging joint instruction classes for employees at the various quarries in their respective districts. From the replies to this letter the Bureau of Mines can ascertain whether or not the number of men desiring training in any particular locality is sufficient to warrant the expense to the Bureau of sending a specially equipped first-aid and mine rescue car and crew to that place for the purpose of giving a complete course in first-aid and granting diplomas to all employees who take the training and pass a satisfactory examination at its conclusion. Your committee has been informed by Secretary Boyd that this letter will be mailed to the entire membership immediately following this convention.

Your Committee, with the approval of the Executive Committee, invited the United States Bureau of Mines and the National Safety Council to exhibit at this convention. Both of these invitations were accepted. The Bureau of Mines, in addition to having an exhibit, has sent a crew of trained men to give demonstrations of first-aid methods, for the benefit of all attending this convention.

On Wednesday, January 19, your Committee on Welfare and Safety held a joint meeting with the Executive Committee of the Quarry Section, National Safety Council, of which Mr. L. R. Cartwright is chairman. At this meeting, the proposals submitted in this report were thoroughly discussed. It was agreed that if the recommendations of your Committee were approved by the Association, the Quarry Section of the National Safety Council will concentrate its energies on the same objectives and coordinate its work during 1927 with that of your Committee on Welfare and Safety for the common good of the members of both organizations.

The report of the Committee on Standards was presented by O. P. Chamberlain on Monday. The report also contained the reports of the two subcommittees and will be published in the next issue.

The following officers were elected for 1927: President, Otho M. Graves, Regional Vice Presidents; Canada, Chas. M. Doolittle, Canada, Eastern, Mortimer Wandell, New York, Central, G. J. Whelan, Ohio, Southern, T. I. Weston, South Carolina, Southwestern, W. F. Wise, Texas, Northern, W. R.

Sanborn, Illinois, and Western, A. R. Wilson, California. Directors: H. E. Blair, Ohio, W. M. Andrews, Ohio, F. W. Schmidt, Jr., New Jersey, C. D. Brewer, Minnesota, A. S. Lane, Mass., F. T. Bucker, Penna., J. W. Stull, Virginia, W. L. Sporborg, New York, A. L. Worthen, Conn., W. W. Boxley, Virginia, Allen Patterson, Ohio, L. R. Cartwright, Ind., O. P. Chamberlain, Ill., Harry Landa, Texas, J. C. King, Ohio, Thos. McCroskey, Tenn., F. C. Murphy, Ill., Stuyvesant Peabody, Ill., James Savage, New York, J. F. Schroeder, Iowa, R. B. Tyler, Russell Rarey, Ohio, F. C. McKee, Penna., A. B. Rodes, Tenn., and Newton R. McDowell, Missouri.

Manufacturers' Division

The Manufacturer Division held its Annual meeting on Thursday afternoon and elected officers for 1927. A. F. King was elected chairman for 1927. The membership expressed its appreciation to Mr. M. B. Garber, retiring chairman, and the other officers for their splendid work during the past year by a rising vote of applause. The complete list of new officers for 1927 are as follows:

Chairman, A. F. King, Marion Steam Shovel Company, Marion, Ohio.

Secretary, J. R. Boyd, National Crushed Stone Association, Washington, D. C.

Regional Vice Chairmen:

Gordon Buchanan, C. G. Buchanan Company, New York City.

R. Giubb, Canadian Explosives, Ltd., Montreal.

H. M. Davison, The Hayward Company, New York City.

E. G. Lewis, The Bucyrus Company, Milwaukee, Wisconsin.

L. W. Shugg, General Electric Company, Schenectady.

C. B. Andrews, Taylor Wharton Iron and Steel Co., High Bridge, N. J.

A. F. King; N. S. Greensfelder, Hercules Powder Company and S. R. Russell, E. I. du Pont de Nemours, were elected to represent the manufacturer division on the Board of Directors of the National Crushed Stone Association. The following were elected to the Board of Directors of the Manufacturer Division:

Geo. G. Armstrong, Armstrong Manufacturing Co., Waterloo, Ia.

W. E. Farrell, Easton Car and Construction Co., Easton, Pa.

M. B. Garber, Sanderson-Cyclone Drill Co., Orrville, Ohio.

R. W. Gillespie, Jeffrey Manufacturing Co., Columbus, Ohio.

Fred A. Gill, Gill Rock and Drill Co., Lebanon, Pa.

N. S. Greensfelder, Hercules Power Co., Wilmington. Del.

E. W. Heath, Fate-Root-Heath Co., Plymouth, Ohio.

J. M. Johnson, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Thomas MacLachlan, Vulcan Iron Works, Wilkes-Barre, Pa.

W. H. Norrington, Robins Conveying Belt Co., New York City.

J. Reynard, Loomis Machine Co., Tiffin, Ohio.

S. R. Russell, E. I. du Pont de Nemours, Wilmington, Del.

B. G. Shotton, Hendrick Manufacturing Co., Carbondale, Pa.

Registration

The following list contains the names of those who registered during the first three days of the Convention.

Active Members

Adams, C. G., The France Stone Co., Bloomville, Ohio.
Adams, W. J., Cushing Stone Co., Schenectady, N. Y.
Albright R. H., Grove City Limestone Co., Grove City, Pa.
Allen, H. B., General Crushed Stone Co., Philadelphia, Pa.
Andrews, Wm. H., Lake Erie Limestone Co., Youngstown, Ohio.
Austin, G. A, Piedmont Corp., Chestatee, Ga.
Avril, Arthur C., The France Stone Co., Toledo, Ohio.
Babcock, B. R., Callanan Road Imp. Co., So. Bethlehem, N. Y.
Bain, H. E., The France Stone Co., Toledo, Ohio.
Galfe, Geo. H., Monon Crushed Stone Co., Monon, Ind.
Bamberger, M. M., Interstate Crushed Stone Co., Springfield, N. J.
Bales, M. M., Elmhurst Chicago Stone Co., Elmhust, Ill.
Beam, P. F., C. C. Beam, Reesville, Ohio.
Beam C. C., C. C. Beam, Melvin, Ohio.
Bennett, A. G., Hagersville Quarries, Hagersville, Ont.
Bengtson, A. L., A. P. O'Lachlin Co., LaGrange, Ill.
Bentley, M. Z., Carborn Limestone Co., Youngstown, Ohio.
Bierkamp, Otto, Quartzite Quarries, Inc., LaVerne, Minn.
Black, G. G., France Stone Co., Detroit, Mich.
Blake, Edwin T., Blake Bros., San Francisco, Cal.
Blake, Roy L., Solvay Sales Corp., Detroit, Mich.
Blakeslee, Albert D., New Haven Trap Rock, New Haven, Conn.
Blakeslee, Harold L., Conn. Quarries Co., Inc., New Haven, Conn.
Bolin, W. D., The France Stone Co., Toledo, Ohio.
Bonnell, L. C., F. T. Upton, Inc., Newark, N. J.
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Brennan, J. E., Kelly Island Lime & Trans. Co., Genoa, Ohio.
Brewer, Chas. D., Duluth Crushed Stone Co., Duluth, Minn.
Brownson, Harold R., Rowe Contracting Co., Malden, Mass.
Buchholtz, Clarence, La., Genessee Stone Prod. Co., Batavia, N. Y.
Blackburn, W. J., Montreal Crushed Stone Co., Montreal, Quebec.
Callaghan, C. R., France Stone Co., Bellevue, Ohio.
Callaghan, R. L., Supply Distributers Corp., Cleveland, Ohio.
Callanan, J. R., Callanan Road Imp. Co., So. Bethlehem, N. Y.
Callanan, Keith M., Callanan Road Imp. Co., Albany, N. Y.
Caldwell, A. B., Genessee Stone Prod. Corp., Batavia, N. Y.

Campbell, R. S., Holston Quarry Co., Knoxville, Tenn.
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Cartwright, L. R., Mid-West Crushed Stone Co., Indianapolis, Ind.
Chamberlain, O. P., Dolese & Shepard Co., Chicago, Ill.
Clark, Harvey N., Dolomite Products Co., Rochester, N. Y.
Cline, C. A., Canada Crushed Stone Corp., Hamilton, Ont.
Cobb, Richard H., Piedmont Corp., Atlanta, Ga.
Collett, John, Mid-West Crushed Stone Co., Indianapolis, Ind.
Coyle, Jas. P., Consumer's Company, Chicago, Ill.
Crums, A. E., France Stone Co., Toledo, Ohio.
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Cushing, J. E., Cushing Stone Co., Inc., Schenectady, N. Y.
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Cox, H. R., Amer. Crushed Rock Co., Delaware, Ohio.
Davis, H. H., France Stone Co., Mansfield, Ohio.
Devonald, D. H., Consumers Co., Chicago, Ill.
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Doolittle, C. M., Canada Crushed Stone Corp., Hamilton, Ontario.
Dow, R. H., The France Co., Tiffin, Ohio.
Downs, Wm., Gordon Crushed Stone, Hagersville, Ont.
Downing, C. E., Beachville White Lime Co., Beachville, Ontario.
Duff, Walter, New Castle Lime & Stone Co., New Castle, Penna.
Eames, Wm. Scott, New Haven Trap Rock Co., New Haven, Conn.
Earnshaw, F. O., Carbon Limestone Co., Youngstown, Ohio.
Evans, Mrs. Grace M., Monon Crushed Stone Co., Monon, Ind.
Evans, E. E., Whitehouse Stone Co., Toledo, Ohio.
Ellwood, Gilbert, New Castle Lime & Stone Co., New Castle, Pa.
Filer, H. J., Grove City Limestone Co., Sharon, Pa.
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Franceschini, James, Kirkfield Crushed Stone, Toronto, Ont.
Fredericks, Geo. J., Consolidated Stone & Sand Co., Upper Montclair, N. J.
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Gaskin, Thos. D., Midland Terra Cotta Co., Detroit, Mich.
Gaut, C. H., Halston Quarry Co., Knoxville, Tenn.
German, Leigh, Beachville White Lime Co., Beachville, Ont.
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Goldbeck, A. T., Director Bureau of Eng., N. C. S. A., Washington, D. C.
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Haelig, William H., Bound Brook Crushed Stone, Bound Brook, N. J.
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Hammerschmidt, R., Elmhurst Chicago Stone Co., Elmhurst, Ill.
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Heimlich, LeRoy Lime & Crushed Stone Corp., LeRoy, N. Y.
Hiety, C. C., The Schumacher Stone Co., Pandora, Ohio.
Hemelich, W. R., LeRoy Lime & Crushed Stone, LeRoy, N. Y.
Hevenor, H. P., Canada Crushed Stone Corp., Hamilton, Ont.
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Patterson, L. E., The Natl. Lime & Stone Co., Findlay, Ohio.
Patterson, Walter, Mid-West Stone Co., Ridgeville, Ind.
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Poorman, L. E., France Stone Co., Toledo, Ohio.
Porter, John E., Granite Rock Co., Watsonville, Calif.
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Ruffing, W. J., France Stone Co., Bellevue, Ohio.
Rarey, Russell, Marble Cliff Quarries Co., Columbus, Ohio.
Rex, B. P., General Crushed Stone Co., Easton, Pa.
Reynolds, Jack, The Natl. Lime & Stone Co., Findlay, Ohio.
Reynolds, Roy, Halston Quarry Co., Liberty, S. C.
Rice, John, Jr., General Crushed Stone Co., Easton, Pa.
Rice, John, General Crushed Stone Co., Easton, Pa.
Robinson, Ralph M., John S. Lane & Son, Inc., Meriden, Conn.
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Rowe, W. E., Hagersville Quarries Co., St. Thomas, Ont.
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Royer, Henry, Material Service Corp., Chicago, Ill.
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Sauvey, I. J., Kelley Island Lime & Trans. Co., Marblehead, Ohio.
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Schroeder, J. F., Linwood Cement Co., Davenport, Iowa.
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Strang, Bert D., Ohio Crushed Stone Ass'n, Columbus, Ohio.
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Tarbox, Frank, Tarbox-McCall Stone Co., Findlay, Ohio.
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Ward, M. R., France Stone Co., Toledo, Ohio.
Watson, D. R., Canada Crushed Stone Corp., Hamilton, Ont.
Weber, J. E., Casper Stolle Quarry & Cont. Co., E. St. Louis, Ill.
Wilson, A. J., Granite Rock Co., Watsonville, Calif.
Wise, W. F., Texas Trap Rock Corp., San Antonio, Texas.
Worthen, A. L., Connecticut Quarries Co., New Haven, Conn.
Wunder, John, Trap Rock Co., Minneapolis, Minn.
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Austin, N. J., Hercules Powder Co., Chicago, Ill.
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Carty, A. C., Symons Bros. Co., Chicago, Ill.
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Davis, Grant, Marion Steam Shovel Co., Marion, Ohio.
Davison, H. M., The Hayward Company, New York City.
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Dodds, Geo., Troco Lubricating Co., Philadelphia, Pa.
Duncan, Walter H., Blaw Knox Co., Pittsburgh, Pa.
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Farrell, J. C., Easton Car & Construction Co., Easton, Pa.
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Fraunfelde, G. D., Easton Car & Construction Co., Easton, Pa.
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Garber, M. B., Sanderson-Cyclone Drill Co., Orrville, Ohio.
Gerow, C. C., Hercules Powder Co., Wilmington, Del.
Goetz, Werner W., Bucyrus Company, S. Milwaukee, Wis.
Good, B. Z., Loomis Machine Co., Tiffin, O.
Cramer, Geo. W., Flexible Steel Lacing Co., Chicago, Ill.
Graham, Roland B., Graham Coal Co., Philadelphia, Pa.
Gracely, Harvey T., Marion Steam Shovel Co., Marion, Ohio.
Greene, Stanley K., Earle C., Bacon, Inc., New York City.
Grubb, R., Canadian Explosives, Inc., Montreal, Que.
Greensfelder, N. S., Hercules Powder Co., Wilmington, Dela.
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Henderson, H. P., Western Wheeled Scraper Co., New York City.
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Holmes, J. W., Canadian Explosives, Montreal, Que.
Hopkins, H. E., Cement Mill & Quarry, Chicago, Ill.
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King, H. C., Hercules Powder Co., Waterville, Ohio.
Kirby, John T., Gill Rock Drill Co., Lebanon, Pa.
Lambert, Max S., Robins Conveying Belt Co., Chicago, Ill.
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Lewis, Edward G., Bucyrus Company, New York City.
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Morrison, J. S., Manganese Steel Forge Co., Pittsburgh, Pa.
Moxley, L. C., Marion Steam Shovel Co., Marion, Ohio.
Mullally, W. J., American Manganese Steel Co., Chicago Heights.
Munday, H. W., Pit & Quarry, Chicago, Ill.
Norrington, Wm. H., Robins Conveying Belt Co., New York City.
Onkst, B. E., Thew Shovel Co., Chicago, Ill.
Pardee, S. A., R. & J. Dick Co., Inc., New York City.
Peirson, H. F., W. S. Tyler Co., Cleveland, Ohio.
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Phillips, Chester A., The Osgood Co., Chicago, Ill.
Piggott, Wallace, J. W., W. S. Tyler Co., Cleveland, Ohio.
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Boothman, Wm., J. M. Brenner Co.
Bowles, Dr. Oliver, U. S. Bureau of Mines, New Brunswick, N. J.
Brandon, Mrs. Harry H., Ohio Marble Company, Piqua, Ohio.
Branham, Geo. A. Branham Quarry Co., Hannibal, Mo.
Brenner, J. M., J. M. Brenner.
Cattell, Dr. E. J., Author and Lecturer, Philadelphia, Pa.
Coburn, R. W., Mass. State Highway Dept., Boston, Mass.
Connor, Arthur F., Bridgeport, Conn.
Conner, C. N., National Research Council, Washington, D. C.
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Donnelly, W. M., Portland Cement Co., Chicago, Ill.
Emery, Alden H., U. S. Bureau of Mines, Pittsburgh, Pa.
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Frederick, Paul S., Barber-Greene Co., Detroit, Mich.
Gaskin, Mrs. Thos. D., 8919 Quincy St., Detroit, Mich.
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Gorden, H. L., Pittsburgh Limestone Co., New Castle, Pa.
Halbert, W. C., U. S. Bureau fo Mines, Vincennes, Ind.
Hansard, O. H., State Highway Dept., Nashville, Tenn.
Hatfield, Fred E., Indiana Limestone Company, Bedford, Ind.
Henderson, Geo. H., State Bd. of Public Roads, Providence, R. I.
Heckman, R. R., Dept. of Highways, Ashland, Ohio.
Hipple, John A., Penn. Lime, Stone & Cement Co., Lancaster, Pa.
Hodgin, C. N., Kokomo Stone Co., Kokomo, Ind.
Holmes, Robert, Wyoming Co. Supt. of Highways, Castile, N. Y.
Hopkins, Mrs. W. E., Oak Park, Ill.
Huges, G. W., Manistique Lime & Stone Co., Manistique, Mich.
Hiff, W. L., Hyatt Roller Bearing Co., Pittsburgh, Pa.
Ireland, Mrs. J. W., Lambertville Stone Quarry Co., Philadelphia, Pa.
Jackson, F. H., Bureau of Public Roads, Washington, D. C.
Johnson, James H., 600 Eddy St., Providence, R. I.
Johnston, Mrs. H. A., Ohio Marble Co., Piqua, Ohio.
Johnston, James H., Asst. Eng. of Providence, Providence, R. I.
Keefer, W. Dean, National Safety Council, Chicago, Ill.
Keever, Mrs. W. J., Marble Cliff Quarries Co., Columbus, Ohio.
Kelley, R. F., Frakn Kelley & Son, Forbonia, Ohio.
Kernan, Mrs. M. L., 206 Walton Road, So. Orange, N. J.
Killen, Thos., Lima Stone Co., Lima, Ohio.
Landa, Mrs. Harry, Landa Rock Prod. Co., New Braunfels, Tex.
Livingston, Arthur, McKinney Marsh & Cushing, Inc., Detroit.
Lytle, B. H., Hyatt Roller Bearing Co., Pittsburgh, Pa.
McCall, Olive, Tarbox-McCall Stone Co., Findlay, Ohio.
McConnaughay, Hayes Construction Co., Indianapolis, Ind.
McKinney, Bernard A., West Roxbury Trap Rock Co., West Roxbury, Mass.
McLean, Mrs. R. E., 1815 Ohio Ave., East St. Louis, Ill.
Moore, W. A., Elliot Service Co., Chicago, Ill.
Morris, L. H., Morris Engineering Co., New York City.
Munsch, Albert A., U. S. Bureau of Mines, Pittsburgh, Pa.
Nicol, W. S., Cross Engineering Co., Carbondale, Penn.
Nicholson, G. J., Manistique Lime & Stone Co., Manistique, Mich.
Norman, D. H., H. T. Routley, Toronto, Ont.
Owens, Mrs. F. C., Auburn, N. Y.
Paterson, Mrs. F. R., Natl. Lime & Stone Co., Findlay, O.
Parker, Geo. A., Chicago Pneumatic Tool Co., Detroit, Mich.
Patnoe, G. W., Engineer, Carey, Ohio.
Pearson, F. J., Winnipeg Supply & Fuel Co., Stonewall, Man.
Perini, Joseph B., Perini & Sons, Framingham, Mass.
Pettey, Fred L., Chicago, Ill.

Porter, H., Hyatt Roller Bearing Co., Newark, N. J.
Rea, Walter, Cleveland Rock Drill Co., New York City.
Rearer, Jos. R., Ohio Hydrate & Supply Co., Woodville, Ohio.
Ripley, Mrs. Theresa, Buffalo Crushed Stone Co., Buffalo, N. Y.
Rockwell, Dean E. H., Consulting Engineer, New Brunswick, N. J.
Schlesinger, G. F., Dir. Highways & Public Wks., Columbus, Ohio.
Sheets, Frank T., Chief Highway Engineer, Springfield, Ill.
Shield, W. L., Peerless Explosives Co., Pittsburgh, Pa.
Showalter, J. C., J. C. Showalter, Lancaster, Pa.
Simonsen, C. S., Peerless Explosives Co., Pittsburgh, Pa.
Sloan, Mrs. V. I., Chicago, Ill.
Stanley, Wm. E., Pearce, Greeley & Hansen, Chicago, Ill.
Strang, Mrs. Bert D., Ohio Crushed Stone Assn., Columbus, Ohio.
Stearns, Earl D., Stearns Conveyor Co., Cleveland, Ohio.
Tarbox, Mrs. Nellie, Tarbox-McColl Stone Co., Findlay, Ohio.
Upham, Chas. M., Engineer, Raleigh, N. C.
Vander Vries, John N., U. S. Chamber of Commerce, Chicago.
Van Voorhis, Mrs. Carl, Columbus, Ohio.
Weigel, W. M., Mo. Pac. R. R., St. Louis, Mo.
Weimer, Hugo W., Consulting Engineer, Milwaukee, Wis.
Williams, Harold, Jr., 54 Devonshire St., Boston, Mass.
Wilson, Riley, R. B. Tyler & Co., Washington, D. C.
Wilson, Loyd, 854 Buhl Building, Detroit, Mich.
Witmer, Fred, Ohio Hyd. & Sup. Co., Woodville, Ohio.
Woodhouse, Mrs. M. J., Chicago, Ill.
Woodhull, Mrs. W. J., Chicago, Ill.
Woolley, C. Lester, Rhode Island State Board of Public Roads, Providence, R. I.
Worthington, A. W., Pittsburgh Limestone Stone, Pittsburgh, Pa.

Lime to Be Subject at Spring Meeting of American Chemical Society

The increasing importance of lime in industry has awakened the interest of scientific men of the country and as a result a symposium on lime has been included in the program of the American Chemical Society for its Spring Meeting at Richmond, Va., April 11 to 16.

Three half-day sessions will be devoted to the technical problems involved in the production and use of this material. The fact that 115 industries use lime in one form or another and that lime touches most of the activities of modern life promises a large attendance and an active interest in the subjects discussed. Men prominent in those industries manufacturing and using lime and chemists interested in investigational work will participate in the presentation of papers and in the discussions. The symposium will bring these three groups together for the consideration of questions of mutual interest.

The extent to which lime is used may be gained from production and sale figures in 1926. In that year lime produced and sold amounted to approximately 5,000,000 tons with a value of $46,500,000 of which about 45 per cent was consumed by the chemical industries. These figures do not include the very large tonnages consumed by those industries which produce their own lime such as alkali manufacturers, the iron and steel industries, carbide producers, sugar refineries, etc.

The men participating in the Chemical Society symposium recognize the value of a thorough knowledge of both the chemical and physical properties of lime and the need for a complete understanding of the principles involved in its proper use. Recent developments along all these lines and including specifications and adaptation of equipment will be presented. In addition to lime manufacture the following important consuming industries, among a large number of others, will be represented: Paper, textiles, leather, glass, metallurgy, refractories, alkali, bleach, soap, agriculture, creamery.

A number of subjects of vital interest to all industrialists, scientists and general public such as water softening and purification, sewage and sanitation, treatment of trade wastes, etc. will be included. This incomplete list indicates the great diversification and wide application of the problems to be considered and establishes the importance of this first lime symposium.

A complete set of abstracts will be published by the National Lime Association in one volume, and will be available April 13. The following recognized authorities in their various lines are included in the list of speakers: P. A. Paulson, Kimberly Clarke Paper Co.; Chas. Warner, Chas. Warner Co.; J. M. Dorr, The Dorr Company; A. H. Hooker, Hooker Electrochemical Co.; Profressor G. I. McLaughlin, University of Cincinnati; C. P. Hoover, Columbus, Ohio, Water Purification Works; L. F. Warrick, Wisconsin State Board of Health; W. E. arson, Riverton Lime Co.; Professor G. L. Clark, Massachusetts Institute of Technology; V. J. Azbe, Consulting Combustion Engineer; Professor O. R. Overman, University of Illinois, R. K. Meade, Consulting Engineer. J. R. Withrow, Head of the Department of Chemical Engineering, Ohio State University, is in charge of preparation for the symposium and will preside.

Handling of Electric Detonators

Electric detonators and squibs should be handled very carefully, cautions the Bureau of Mines. Rough handling may break the bridge-wire connections. Bringing electric detonators into contact with any source of current may cause enough current to flow in the bridge wires to heat them to firing temperature. Serious accidents may result from the explosion of the detonator alone.

The best practice, and the one which is required by law in several states, is to keep electric detonators in nonconductive boxes or bags until the shot firer is about to use them, and then to remove only the supply immediately needed.

ELEVENTH SAND AND GRAVEL CONVENTION SUCCESSFUL FROM EVERY ANGLE

THE eleventh Annual Convention of the National Sand and Gravel Association was held at the Hotel Gibson, Cincinnati, Ohio, January 17th, 18th and 19th, 1927. A meeting of the committee on specifications for standardized sizes of sand and gravel was held on Monday morning, January 17th for the purpose of reviewing the work of the committee during the past year. At this meeting a resolution was prepared asking that this committee be established as a standing committee of the National Sand and Gravel Association.

The annual meeting of the Board of Directors was convened at a luncheon on the same day, luncheon being served at the Hotel Gibson. At this meeting were considered the preparation of plan of activities for the Association during the ensuing year, and a budget to cover such activities. These were submitted to the convention as a whole on Tuesday at the afternoon meeting. At the luncheon nomination of candidates for the offices of President, Vice-President and Secretary-Treasurer, and also for three Directors at Large with a selection from their own number of four members of the Executive Committee for the year 1927 were made.

The morning session of the second day, Tuesday, January 18th, was opened by Hugh Haddow, Jr., President of the Association who made a short address speaking on the work and value of the Association to the Sand and Gravel Industry. Mr. Haddow said that much of the success of the meetings, which he might forecast, was largely due to the loyal support and hard work which has been given by the local committee of the Association, which had been under the supervision of Mr. Fred E. Hall, Chairman of the General Committee who was then called upon to make a few remarks.

In his interesting talk Mr. Hall said that he should not receive too much credit as he had only done as he was told and whatever success came from the Convention was a result of the united efforts of all the members of the local committee.

The Mayor of Cincinnati, Hon. Murray Seasongood, was then introduced and made an address of welcome to the Association. In his remarks the mayor related the policy of control under which the city is governed stating that the open bidding system is used exclusively for the letting of contracts. This he said had been found to be the best method for the city as each firm had an equal chance to obtain the contract and the results were that lower prices were obtained which enabled the taxes to be kept down, which is of interest to all tax-payers of the city.

He paid a high tribute to the Sand and Gravel industry as regards its dealings with all work which he had come in contact with during his connection with the political life of the city, and he therefore was very anxious that all the members of the Association should receive a hearty and friendly welcome to the City of Cincinnati.

Mr. G. S. Brown, President, Portland Cement Association, was then called upon to present his paper on the "Value of Industrial Associations." During his remarks he said that the first stretch of cement road in the world was laid in Wayne County, Michigan, in 1909. Now one fourth of the cement production of the United States goes into roads and with persistent advertising and publicity that percentage will no doubt increase. He also remarked that care should be taken not to raise prices in this industry to such a degree that other materials can be substituted. This, he said, would be easily possible with cement and might also be possible in the sand and gravel industry, on the other hand, he said, prices should be raised so that the best material is produced and have a fair margin of profit to the producer. Mr. Brown also spoke on the studies which are being made by the Portland Cement Association on various uses for concrete and how the results of this research is sent out to the public in order to educate them in a scientific manner.

Continuing, he said that a few years ago accidents in the cement industry were very high but now the accident prevention system in vogue is considered the best in America. In 1922 The Portland Cement Association started to award a trophy for the best results in accident prevention and in 1925 two mills had perfect records which was again duplicated last year. Mr. Brown also spoke on the cost of cement which in 1919 was 35 per cent higher than 1925 and this reduction can be attributed to a marked degree in research work of the Association which has one of the largest laboratories in the world, located in Chicago and occupies three entire floors. The value to the public of this improved concrete, which is determined by research, is the making of better streets and highways in the country.

Reports of the various activities of the Association's staff and committee were then in line to be presented, but as these were printed in pamphlet form and it was then time for adjournment, Mr. Haddow, Jr., said that these reports would not be read at the meeting. However, J. L. Shiely, Secretary-Treasurer, said the financial condition of the Association was the best since the inception of Sand and Gravel Association. Mr. Stanton Walker made a few remarks regarding the value of Engineering research, which is under his supervision and

Stephen Stephanian, Chairman, read a portion of the report of the Committee on Specification for Standardized Sizes of Sand and Gravel. The meeting then adjourned.

At the afternoon session the names of nominated candidates for offices of the Association were read and elected in open meeting. These were Hugh Haddow, Jr., Millville, New Jersey, President of the Association was re-elected President, H. H. Halliday, Cairo, Illinois, Vice-president, succeeding R. C. Fletcher, and Earl Zimmerman, Cincinnati, President of the Ohio Sand and Gravel Producers' Association, was elected Secretary-Treasurer. V. P. Ahearn, Washington, D. C., was re-elected Executive Treasurer and Stanton Walker, Washington, D. C., was re-elected Director Engineering and Research Division.

The Directors elected were R. D. Potts, Dallas, Texas, J. L. Shiely, St. Paul, Minnesota, R. C. Fletcher, Des Moines, Iowa, J. D. Roguemore, Montgomery, Alabama, and Stanton Walker, Director of the Engineering and Research Division, Washington, D. C.

The Association also elected three directors-at-large. They are F. D. Cappock, Greenville, Ohio, G. D. Peck, Kansas City, and Harry Davison, Pittsburgh, Pennsylvania. John Prince, Stewart Sand Company, Kansas City, Missouri, at this time paid a tribute to the work of Mr. T. R. Barrows who was the late Executive Secretary of the Association and who passed away during the last year.

W. J. McGarry, Manager Open Top Car Section, American Railway Association then presented a paper "Transportation Problems as Related to the Sand and Gravel Industry." In this paper he declared that as long as the American Railway Association had an influence in railroad circles, it would never lend itself to favoring priority orders

that would take railroad equipment away from one industry to benefit another.

Mr. McGarry voiced the opinion that business conditions in the Sand and Gravel industry would be similar to 1926. The increase of the industry has been very marked and last year 2,614,000 cars were loaded with products of the industry. This shows an increase in percentage of 35.4 and he stated that this had been handled with practically no increase in the amount of open type cars.

He also mentioned the strenuous times during the British coal strike when coal has to be moved at all cost yet by the cooperation of the railroads and shippers this material as well as other commodities were moved wtih practically no delay or car shortages and much of the credit should be given to the Regional Advisory Boards of which there are 14 in the United States. A short discussion followed the paper dealing with the subject of whether the railroads are making an increase in cars to which Mr. McGarry replied that each railroad is being investigated and each asked to supply enough cars to meet demands to prevent any car shortage.

F. J. Stimson then presented his paper "A Better Railroad Ballast." In his remarks he said the first ballasts were chiefly cinders, gumbo, etc. but owing to the complaints of the travelling public better, smoother riding road beds had to be made. In this ballast large stones were removed as the first improvement, then the gravel was washed but no attempt was made to proportion the aggregates. However, when heavier rolling stock was used and moving at an increased speed the using of better ballast was necessary. With the older engines travelling at only 20 miles per hour the former type of ballast was satisfactory but the modern train moving at 75 or more miles per hour de-

manded the better railroad ballast now being used. He said that trains moving up to 40 miles per hour did not cause much dust but over that speed the train sucks up the dust from the road bed and ballast must be used from which dust has been removed by washing and properly proportioning aggregates. Further, better ballast keeps the tracks in line and enables the service to operate longer without repairs.

In his paper "The Value of Sand and Gravel Traffic to the Railroads" Edwin Brooker said that the sand and gravel industry is paying more than its proper share of the revenues on transportation of the carriers. Hauling sand and gravel entails no risk by the railroads. There is much less risk hauling sand and gravel than there is in hauling livestock. Again the sand and gravel hauls normally over short distances and use very little terminal facilities. The sand and gravel industry is paying its share of the transportation revenues of the railroads.

The last paper of the day was by C. R. Stokes, Manager Highway Bureau, National Lime Association, on the subject "Co-operation of Two Industries." In this paper he pointed out the connection between the two industries: Sand and Gravel and Lime. He also mentioned here how one depended on the other for the success of the product to be made such as glass, where both sand and lime are used. Methods in the production of lime such as slacking and hydration were discussed. The preparation of highways and the use of both industries and how efficient methods were demanded. Lime added to concrete improved the mix and the use of lime in asphalt paving. Construction of buildings and Sand-Lime brick were also mentioned as examples of this principle of desired co-operation. Finally he pointed out where a closer contact between these associations would be of benefit to the members. The meeting adjourned shortly before 5 o'clock.

The annual dinner and dance was given in the evening at the Hotel Gibson at which about 375 were present. After the dinner a vaudeville entertainment was provided during which Mrs. Stephen Stepanian, Columbus, Ohio, led the singing of a number of Association songs which she had composed.

The first paper at the morning session on Wednesday, January 19, 1927, was by Frank W. Welch, Chief Engineer, the Greenville Gravel Corporation, on the "Design of Sand and Gravel Plants." During his remarks Mr. Welch spoke of a practice which he used at the Webster Manufacturing Company where a questionnaire was sent out to be filled in before any attempt was made to design a plant for any customer because from the answers received to these questions they had some facts upon which to work in the design, all must be special to meet the conditions of the case. The several leading features of a plant were then discussed from the deposit to the loading bins. In his opinion the best place for the screens were the top of the main building, the material being conveyed there before any attempt at screening was made. Individual drives for all machines, with the possible exception of the crushers, was recommended by the speaker. He also favored loading direct from the screens, using as few storage bins as possible with the exception of plants near to large cities, where some bins should be provided in order to serve large shipments. He also favored plants made of structural steel mounted on concrete foundations.

Gordon Smith, Secretary, J. C. Buckbee Company, then read a paper "Factors Entering into the Design of Sand and Gravel Washing Plants." Mr. Smith said that the remark had often been made that Sand and Gravel could not be granded, yet the Northern Gravel Company were now branding their product as the "Barton Washed Sand and Gravel." Slides of two plants designed by the Buckbee Company were then shown to illustrate two modern, though differently designed washing plants. The first was that of the Chicago Gravel Company at Oswego, New York, and the second that of the Crystal Lake, Ill. The various features in the two designs were described during the showing of the various slides. A short discussion followed when it was said that 14 foot clearance above the tracks and bottom of loading bins had been found satisfactory and 17 foot centers between parallel tracks at loading bins had proved to be ample.

Albert E. Reed, W. S. Tyler Company then presented a paper "New Developments in Screening Plant Design" in which he discussed the features in revolving screens and vibrating screens and the advantages of the latter. His talk was well illustrated by lantern slides showing application of the vibrating screen to various types of plants and screening operations.

The next speaker was Fred W. Cornuelle, Red Bank Gravel Company, whose subject was "Constructing a Gravel Washing Plant for Truck Service." In this paper the speaker recommended driveways at least 9½ feet wide and recommended concrete bins to hold the gravel. The washing machines should be designed as simply as possible with individual drives to each. Where equipment could not be direct driven, speed reducers should be employed as they had been found to afford the best satisfaction for reducing the speeds from the motor. He also recommended that the crushers be placed on the ground if at all possible.

The last speaker at the morning session was D. A. Abrams, Director, Research Laboratory, Portland Cement Association, who took for his subject, "Importance of Industrial Research." The speaker mentioned the importance of research to industry stating that research was the discovery of nature's truths and laws. To illustrate this fact he spoke

on the discoveries of aluminum, electrical equipment, artificial silk, automobiles and its many developments. In the research in cement this has been not only its proper manufacture but also correct use. In this connection the Portland Cement Association employs 40 people at their own laboratory. Part of this research during the past year has been to determine the proper amount of water to place in the mixing bath as they have found that this is very important. It has been found that by having the proper mix the proper strength of roads can be obtained in a shorter time than what was possible formerly. He said that similar research should be given to sand and gravel to determine such factors as proper sizes and grading, workability of concrete. Specifications should also be made more definite calling for the hardness of the various materials.

In conclusion the speaker said that the success of this country had been brought about by taking a chance on research. The meeting then adjourned.

The first paper at the afternoon session was by Judge William A. Hough, Indiana State Tax Commission, on the subject "Taxation for Public Construction." In his remarks the Judge said that the state of any civilization was shown by its roads, as civilization improved the roads were also improved and then spoke of taxation which was necessary to meet the cost of these improved roads. He said that the policy of the State of Indiana as regards its roads was to pay-as-you-go, and that about 15 millions of dollars would be expended during the present year and this money would be ready to pay for these improved roads before the end of the year. He said that the only way for any city or state to reduce its taxation was to run them in a strictly business way.

These remarks were followed by a paper by A. S. Rea, Engineer of Tests, Ohio Department of Highways and Public Works, on "Mineral Aggregates for Highway Construction." The speaker said that Ohio had more types of highways than any other state in the Union, and about 90 per cent of all roads are mineral aggregates. He then mentioned some of the various types of roads in the state and the length of each. Roughly two-thirds of these roads are hard paved and the other third gravel surface roads. The specifications used in the state call for 23 grades of aggregates but the speaker said that no doubt many of these types would be eliminated during 1927. At present there are 9 grades of fine sand and 14 grades of coarse aggre-

The Manufacturers Exhibit.

gates, which are fully covered in the specifications. As an example, grade A, which is used for concrete pavement, calls for 95 per cent to pass a ¾ inch ring.

R. L. Morrison, Director, Michigan State Highway Laboratory, then presented his paper "Gravel Inspection Methods Used in Michigan." In this paper the speaker told how the inspection methods have changed during the past decade. Not many years ago plants did not favor inspection methods and inspectors made a practice of rejecting cars in order to hold their jobs. However this has been changed, now firms are most anxious to meet the specifications and the inspection methods now used are more scientific, not so much a guess procedure. Again inspectors are now first trained at the laboratory and then when sent to different plants much of the knowledge they have gained can be given to plant owners so that these inspectors are welcomed at a plant.

This research deals not only with an analysis of the deposits but also the best methods of installation and use of plant equipment. The inspectors work at the plant is to analyze each operation from the deposit to the loading bin and then advise and instruct, where necessary, the executives of the particular plant. These inspection methods at the plant are a great help in finding aggregates not to specifications before the material reaches the place where it is to be used when a second check or inspection is made.

The last paper of the convention was given by Frederick C. Field, Chemist, The Asphalt Association, on the subject "Sand and Gravel in Asphalt Pavement." In his remarks Mr. Field spoke on the use of Asphalt in highway construction but said that Black base was now necessary where heavy traffic predominated. As sand is used in all asphalt paving the subject of this paper was timely for such a convention. Regarding the sand used it had been found that though certain sand would be unsuitable in some localities on other roads it would be very satisfactory. To meet such conditions the specifications should be changed, as regards the sand, thereby the roads would be made cheaper. The meeting then adjourned at 4:30 P. M.

Adjoining the room where the meetings were held was an exhibition room divided into 45 booths, where many models of sand and gravel plant equipment were on exhibition. This section was well attended throughout each day and as this was the first of these exhibitions it speaks well for the benefits to be derived from such concrete examples to amplify the papers given during the convention.

Much of the success of the entire convention can be attributed to the work of the local general committee under the guidance of F. E. Hall, Chairman. This committee by their untiring effort and foresight removed many ot the obstacles sometimes found at conventions and enabled the Association to enter on the work of the three days feeling the genuine hospitality and friendly spirit of the City of Cincinnati. Invitations have been received through the Mayors of Philadelphia, New Orleans and Detroit to hold the next convention at one of these cities, but the place for this next gathering will not be decided until the early summer of this year.

Registration

Adams, C. A., Madison Sand & Gravel Corp., Madison, N. Y.
Adams, Chas. H., Climax Engineering Co., Clinton, Ia.
Adams, L. J. and Mrs., Ohio Gravel Ballast Co., Columbus, Ohio.
Ahearn, V. P., National Sand & Gravel Association, Washington, D. C.
Aldous, Joseph C., Mississippi Lime & Material Co., Alton, Ill.
Alexander, David, Petersburg & Dixie Sand & Gravel Corporation, Petersburg, Va.
Almquist, E. A., Eagle Iron Works, Des Moines, Ia.
Armstrong, W. C., Mid-West Locomotive Works, Cincinnati, Ohio.
Arnold, Douglass L., Fairbanks-Morse & Co., Chicago, Ill.
Artz, Fred E., Marion Steam Shovel Co., Marion, Ohio.
Ault, C. M., Barnes Sand & Gravel Co., Piketon, Ohio.
Bailey, I. R., Dayton Whirley Co., Dtyton, Ohio.
Baker, Guy C., Greenville Gravel Corp., Greenville, Ohio.
Baldwin, F. G., The Baldwin-Tarvin Co., Cincinnati, Ohio.
Battjes, H. R. and Mrs., Grand Rapids Gravel Co., Grand Rapids, Mich.
Baughman, R. H., The Morrow Mfg. Co., Wellston, Ohio.
Beauskid, Jack, Nat'l. Sand & Gravel Co., Morrisville, Pa.
Bebout, G. B., Muskingum River Gravel Co., Zanesville, O.
Beerman, Fred R., Atlas Rock Co., Stockton, Calif.
Behnke, Geo. W., Simplicity Engineering Co., Durand, Mich.
Bennett, Wm. H. K., W. H. K. Bennett Co., Chicago, Ill.
Berger, J. Fennell, The New Jersey Wire Cloth Co., Trenton, N. J.
Berninger, Wm., A. Leschen & Sons Rope Co., St. Louis, Mo.
Biesanz, Chas. P., Biesanz Stone Co., Winona, Minn.
Bilisoly, J. M., The Door Co., Chicago, Ill.
Bingham, F. A., Northern Gravel Co., West Bend, Wis.
Bird, Paul P., Boston Sand & Gravel Co., Boston, Mass.
Blakemore, A. L., American Manganese Steel Co., Chicago, Ill.
Blanton, J. B., J. B. Blanton Co., Frankfort, Ky.
Bliss, W. A., Keystone Sand & Supply Co., Pittsburgh, Pa.
Boldebuck, A. W., Thomas Elevator Co., Chicago, Ill.
Bond, J. S., Allis Chalmers Mfg. Co., Milwaukee, Wis.
Bowers, A. W., Cincinnati Rubber Mfg. Co., Cincinnati, O.
Bowker, J. E., Birnie Sand & Gravel Co., N. Wilbraham, Mass.
Bray, A. L., Taylor-Wharton Iron-Steel Co., Pittsburgh, Pa.
Brinley, C. C., Gefford-Wood Co., Chicago, Ill.
Brokate, George, Home Sand Co., Fremont, Ohio.
Brooker, Edwin, Commerce Counsel, Washington, D. C.
Brown, W. N., Keystone Gravel Co., Dayton, Ohio.
Bullen, J. A., Fountain Sand & Gravel Co., Pueblo, Colo.
Burnside, E. T., Shelbyville, Ind.
Burt, L. B., National Lime Assn., Washington, D. C.
Burton, H. S., Queen City Supply Co., Cincinnati, Ohio.

Caldwell, H. P., Ohio River Sand Co., Louisville, Ky.
Caleuss, R. C., Chas Warner Co., Philadelphia, Pa.
Callahan, David G., The M. A. Callahan Co., Cleveland, O.
Campbell, L. W., The Dayton Gravel & Sand Co., Dayton, Ohio.
Carr, Bradley S., American Manganese Steel Co., Chicago, Ill.
Carroll, J. E. and Mrs., J. E. Carroll Sand Co., Buffalo, N. Y.
Carroll, Weston M., J. E. Carroll Sand Co., Buffalo, N. Y.
Casey, W. F., W. Fred Casey & Co., Charlotte, N. C.
Chaffee, F. W., General Concrete Prod. Corp., Warren, Pa.
Climo, G. F., Brown Hoisting Machy. Co., Cleveland, O.
Codell, J. C., Winchester Sand & Gravel Co., Winchester, Ky.
Collins, Rose and Sister, Spruce Pine, Sand & Gravel Co., Spruce Pine, Ala.
Connor, John J., Bartlett Hayward Co., Baltimore, Md.
Cook, Geo. H., Stewart Sand Co., Kansas City, Mo.
Coolidge, R. N., Dravo Contracting Co., Pittsburgh, Pa.
Conrades, O. S., St. Louis Material & Supply Co., St. Louis, Mo.
Coppock, F. D., Greenville Gravel Corp., Greenville, O.
Cornuelle, Fred W. and Mrs., The Red Bank Gravel Co., Cincinnati, Ohio.
Courtney, A. C., Branch Hill, Ohio.
Crisler, C. W., Potts Moore Gravel Co., Waco, Texas.
Crusey, W. H., Geo. L. Rock Inc., Cincinnati, Ohio.
Cuny, Earl P., Sane, Titusville, Pa.
Dalrymple, C. E., Raritan River Sand Co., New Brunswick, N. J.
Daniels, A. W., American Manganese Steel Co., Chicago, Ill.
Dann, Alex W., Keystone Sand & Supply Co., Pittsburgh, Pa.
Dann, B. G., Hendrick Mfg. Co., Carbondale, Pa.
Dannel, S. P., London Sand & Gravel Co., London, Tenn.
Darnell, L. P., Cincinnati Rubber Mfg. Co., Cincinnati, O.
Davant, H. W., The Osgood Co., Marion, Ohio.
Davidson, James R., Cincinnati Quarries Co., Cincinnati, Ohio.
Danis, A. E., T. J. Hall & Co., Cincinnati, Ohio.
Davison, H. M., The Hayward Co., New York, N. Y.
Davison, H. S., J. K. Davison & Bro., Pittsburgh, Pa.
Deletombe, W. E., Dixie Sand & Gravel Co., Chattanooga, Tenn.
Dienhart, E. W., Acme Concrete Products & Gravel Co., Cement City, Mich.
Dillard, John L., The Sturm & Dillard Co., Syracuse, Ind.
Donnelly, Dan and Mrs., The O. G. B. Co., Cincinnati, O.
Donnelly, Harry, The Ohio Gravel Ballast Co., Cincinnati, Ohio.
Donnelly, R. N., Ohio Gravel Ballast Co., Cincinnati, O.
Donnelly, Wm., Ohio Gravel Ballast Co., Cincinnati, O.
Doran, George W., The Red Bank Gravel Co., Cincinnati, Ohio.
Drach, Louis, Cincinnati Quarries Co., Cincinnati, O.
Duffy, J. H., Ohio River Sand Co., Louisville, Ky.
Dugan, J. N., Cincinnati, O.
Durnell, J. L., Van Service Corp., Philadelphia, Pa.
Dyament, L. T., Ward Sand & Gravel Co., Oxford, Mich.
Earnshaw, George M., Rock Products, Chicago, Ill.
Edwards, C. S., Ft. Worth Sand & Gravel Co., Ft. Worth, Texas.
Edwards, V. B., The Dravo Contracting Co., Pittsburgh, Pa.
Enochs, J. H., Harnischfeger Sales Corp., Milwaukee, Wis.
Estes, G. M., Ohio River Sand & Gravel Co., Cincinnati, Ohio.
Euler, O. B., Simplicity Engineering Co., Durand, Mich.
Fitzpatrick, Joseph F., Fitzpatrick Sand & Gravel Co., Worcester, Mass.
Fletcher, R. C., Flint Crushed Gravel Co., Des Moines, Ia.
Foland, D. S., The Keystone Gravel Co., Dayton, O.
Folz, A. G., Sauerman Bros., Chicago, Ill.
Fox, J. R., Page Engineering Co., Chicago, Ill.
Forschner, A. J., R. H. Beaumont Co., Philadelphia, Pa.
Frosch, A. E., East Liverpool Sand Co., E. Liverpool, O.
Frink, M. R., Simplicity Engineering Co., Durand, Mich.
Fuller, F. C., Portsmouth Sand & Gravel Co., Portsmouth, Ohio.
Furrow, J. Earl, Visitor, Muncie, Ind.
Gayle, Jas., Carrollton Sand & Gravel Co., Carrollton, Ky.
Goldberg, Abe., Allis Chalmers Mfg. Co., Milwaukee, Wis.
Goodwin, R. A., Cement Mill & Quarry, Chicago, Ill.
Gorman, J. J., Zanesville Washed Gravel Co., Zanesville, Ohio.
Gower, Geo. F., Simplicity Engineering Co., Durand, Mich.
Gracely, Harvey T., Marion Steam Shovel Co., Marion, O.
Gregory, James H., Barber-Greene Co., Aurora, Ill.
Groves, Roy and Mrs., The Ohio Gravel Ballast Co., Cincinnati, Ohio.
Haddow, Mr. and Mrs. Hugh, Jr., Menantico Sand & Gravel Co., Millville, N. J.
DeHart, Mr. and Mrs. H. P., W. S. Tyler Co., Cleveland, Ohio.
Hall, Mr. and Mrs. D. P., T. J. Hall Co., Cincinnati, O.
Hall, F. E. T. J. Hall Co. and Ohio Sand & Gravel Co., Cincinnati, Ohio.
Haliday, Mr. and Mrs. H. H., Hallidy Sand Co., Cairo, Ill.
Handman, C. Taylor, The C. Taylor Handman Co., Cincinnati, Ohio.
Hardyman, J. F., Linstone L. & F. Co., Maysville, Ky.
Hart, L. F., Wabash Sand & Gravel Co., Terre Haute, Indiana.
Harton, E. E., Midland Barge Co., Midland, Penn.
Harris, D. C., Browning Crane Co., Cleveland, Ohio.
Heiser, John B., Galion All Steel Body Co., Martin-Parry Corp., Galion, O.
Henzerling, E. J., The Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Hill, G. G., Halleck & Hill Gravel Co., Bloomfield, Mo.
Hill, I. Rutledge, Gifford-Hill & Co., Inc., Dallas, Texas.
Hissrich, Henry R., Goodman Engine & Machine Co., Pittsburgh, Pa.
Hobbie, H. M., Roquemore Gravel Co., Montgomery, Ala.
Hoffman, Mr. and Mrs. Herbert H., Geo. J. Hoffman Co., South Bend, Ind.
Holnadel, E. P., The Red Bank Gravel Co., Cincinnati, Ohio.
Homer, C. A., Missouri Portland Cement Co., St. Louis, Mo.
Hoolihan, Clifton, The Keystone Gravel Co., Dayton, O.
Hougland, H. J., Eagle Sand & Gravel Co., Inc., New Orleans, La.
Howard, Walter D., Byrne Conway Co., Cincinnati, O.
Huber, Leo and Mrs., F. G. Ader Constr. Co., Newport, Ky.
Huntington, C. S., Link-Belt Co., Chicago, Ill.
Iler, Jacob, Dayton Gravel & Sand Co., Dayton, O.
Ireland, C. D., Montgomery Gravel Co., Montgomery, Ala.
Jameson, Henry, C. Haylor Handman Co., Cincinnati, O.
Johnston, V. O., Lincoln Sand & Gravel Co., Lincoln, Ill.
Jonett, F. J., Winchester Sand & Gravel Co., Winchester, Ky.
Jones, F. H., The Dorr Company, New York, N. Y.
Jones, L. B., The Browning Crane Co., Cleveland, O.
Jurgensen, W. A. and Mrs., Ohio Gravel Ballast Co., Cincinnati, O.
Kelly, Harry P., Blaw-Knox, Cincinnati, O.
Kammer, Edward, The Keystone Gravel Co., Dayton, O.

Kersting, B. H., The Dravo Contracting Co., Pittsburgh, Pa.
King, H. C., Martin-Parry Corp., Norwood, O.
Krigger, A. H., Brookville Locomotive Co., Pittsburgh, Pa.
Kuenzh, Mr. and Mrs. L. A., The Eden Gravel Co., Upper Sandusky, O.
Lange, Lillian, Queen City Crushed Stone & Sand Co., Cincinnati, O.
Lichtinger, A. J., G. H. Williams Co., Erie, Pa.
Lloyd, Joseph E., The E. T. Sliden Co., Louisville, Ky.
McCarren, W. P., W. P. McCarren, Hannupburg, O.
McDonald, W. S., R. & J. Dick Co., Inc., Cleveland, O.
McGarry, W. J., American Ry. Assn., Washington, D. C.
McGaw, Joseph R., Ohio River Sand Co., Pittsburgh, Pa.
McHaffie, George, Paris Sand & Gravel Co., Hamilton, O.
McLaughlin, C. T., General Electric Co., Schenectady, N. Y.
McMay, Allis Chalmers Mfg. Co., Cincinnati, O.
McQuowan, A. N., Consumers Sand Co., Topeka, Kan.
Maher, Frank M., Ideal Sand & Gravel Co., Salt Lake City, Utah.
May, E. P. and Mrs., Union Sand & Gravel Co., Huntington, W. Va.
Marson, Jack, Barber-Greene Co., Aurora, Ill.
Marsters, J. L., Arrow Sand & Gravel Co., Columbus, O.
Mawson, Robert, Pit & Quarry, Chicago, Ill.
Maynard, Poole, Atlanta-Birmingham & Coast R. R., Atlanta, Ga.
MacWeill, H., Winchester Sand & Gravel Co., Winchester, Ky.
Metcalfe, J. G., Louisville & Nashville R. R., Paris, Ky.
Miller, Howard, Elliott Machine Corp., Baltimore, Md.
Miller, H. J., H. J. Miller Lumber Co., Seattle, Wash.
Miller, R. M., Blaw-Knox Co., Pittsburgh, Pa.
Moloney, Mary A., Ohio Gravel Ballast Co., Cincinnati, O.
Moore, G. R.. Sauerman Bros., Inc., Chicago, Ill.
Morgan, D. H., T. J. Hall & Co., Covington, Ky.
Miner, Raymond, Webster Mfg. Co., Cincinnati, O.
Morrill, Albert H., Ohio Gravel Ballast Co., Cincinnati, O.
Morris, J. A., American Ry. Assn., Cincinnati, O.
Murtaugh, J. F., American Manganese Steel Co., Chicago Heights, Ill.
Nagle, Perry, American Manganese Steel Co., Chicago Heights, Ill.
Nichols, G. L., Maine Sand & Gravel Co., Portland, Me.
Nicol, Warren S., Cross Engineering Co., Carbondale, Pa.
Nickerson, J. C., L. & N. R. R., Paris, Ky.
Nevillis, C. F., Western Indiana Gravel Co., Terre Haute, Ind.
Norton, O. S., E. T. Burnside Gravel Co., Farisland, Ind.
Nugent, Frank J., Kopple Industrial Car & Equipment Co., Pittsburgh, Pa.
Olsen, Harold, Vulcan Iron Works, Wilkes-Barre, Pa.
Owen, A. E., Niagara Concrete Mixer Co., Buffalo, N. Y.
Palmer, A. L., Cincinnati, Rubber Co., Cincinnati, O.
Patty, C. E. and Mrs., Greenville Gravel Corp., Greenville, O.
Peck, F. W., Muncie Sand Co., Kansas City, Mo.
Peffey, Chas. M., Keystone Gravel Co., Dayton, O.
Perrin, A., Pit & Quarry Co., Chicago, Ill.
Peterson, H. W., Stephens-Adamson Mfg. Co., Huntington, W. Va.
Phange, Henry and Mrs., Queen City Crushed Stone & Sand Co., Cincinnati, O.
Pinkham, E. W., Lockwood Greene & Co., Inc., Boston, Mass.
Pirnie, P. M., Muncie Sand Co., Kansas City, Mo.
Podlesak, G. J., Fairbanks, Morse Co., Chicago, Ill.
Poland, J. F., Brown Hoisting Machinery Co., Cleveland, Ohio.
Pinngle, W. Dick, The W. S. Tyler Co., Cleveland, O.
Pundum, C. H., The Sturm & Dillard Co., Syracuse, Ind.
Prince, John, Stewart Sand Co., Kansas City, Mo.
Proctor, Ed., Genesee Gravel Co., Mt. Morris, Mich.
Purdy, E. W., Killbuck Sand & Gravel Co., Killbuck, O.
Purdy, W. W., Killbuck Sand & Gravel Co., Killbuck, O.
Potts, Robt. J., Potts-Moore Gravel Co., Waco, Texas.
Purcell, W. R., The Ohio Gravel Ballast Co., Cincinnati, Ohio.
Puryear, S. R., Perfect Classifier Co., Inc., Nashville, Tenn.
Quigley, R. M., Ft. Worth Sand & Gravel Co., Ft. Worth, Tex.
Read, E. C., U. S. Rubber Co., Cincinnati, O.
Redfield, A. W., United Fuel & Supply Co., Detroit, Mich.
Reed, Albert E., The W. S. Tyler Co., Cleveland, O.
Reed, J. W., Cincinnati Rubber Mfg. Co., Cincinnati, O.
Reifsnyder, H. G., Orr & Semblower, Reading, Pa.
Reinke, F. J., St. Louis Material & Supply Co., St. Louis, Missouri.
Renzenberger, F., The Marion Steam Shovel Co., Marion, Ohio.
Richmond, J. L. and Mrs., Union Sand & Gravel Co., Huntington, W. Va.
Risley, F. A., Madison Sand & Gravel Co., Solsville, N. Y.
Ritter, M. L., Farrell Cheek Steel Fdy. Co., Sandusky, O.
Rockwood, Nathan C., Rock Products, Chicago, Ill.
Roquemore, J. D., Roquemore Gravel Co., Montgomery, Ala.
Rondebush, B., The Ohio Gravel Ballast Co., Cincinnati, Ohio.
Ross, G. C., East Liverpool Sand Co., E. Liverpool, Ohio.
Ruckstubl, Edwin W., Willey-Ruckstubl Co., Cincinnati, O.
Ryder, Harold C., The Hayward Co., New York, N. Y.
Schaeffer, Alfred J., W. A. Jones Fdry. & Mach. Co., Chicago, Ill.
Schiefer, H. S., R. H. Beaumont Co., Cleveland, O.
Schifflin, A. K., Link-Belt Co., Chicago, Ill.
Scholer, E. E., Mo. Valley Sand & Gravel Assn., Kansas City, Mo.
Schreck, Ed. and Mrs., Concrete Material Co., Columbus, Ohio.
Seaman, C. L., Niagara Concrete Mixer Co., Buffalo, N. Y.
Shaw, Edmund, Rock Products, Chicago, Ill.
Shennan, Wm. J., Paxson Taggart, Inc., Philadelphia, Pa.
Shiely, J. L., J. L., Shiely Co., St. Paul, Minn.
Shivers, W. E., Ohio River Gravel Co., Parkersburg, W. Va.
Simmes, Robert, Iron Clad Block Co., Newport, Ky.
Smart, R. W., R. W. Smart, Cinti. Big 4 RR.
Smith, Capt. Chas. A., J. K. Davison & Bro., Pittsburgh, Pa.
Smith, E. B., Waterbury Co., Chicago, Ill.
Smith, Frank B., Bucyrus Co., Pittsburgh, Pa.
Smith, Gordon, Northern Gravel Co., West Bend, Wis.
Smith, W. L., Memphis Stone & Gravel Co., Memphis, Tenn.
Sontag, John, Queen City Concrete Co., Cincinnati, O.
Stannert, H. J., H. J., Stannert Sand Co., Northumberland, Pa.
Stein, Geo. G., Fate-Root-Heath Co., Cleveland, O.
Stepanian, Stephen & Mrs., The Arrow Sand & Gravel Co., Columbus, O.
Stinson, H. T., Queen City Crushed Stone & Gravel Co., Cincinnati, O.
Stokes, C. R., National Lime Assn., Washington, D. C.
Strube, H. L., Link-Belt Co., Philadelphia, Pa.
Sturm, L. E., The Concrete Material Co., Columbus, O.
Suiter, E. B. & Mrs., The Suiter Material & Transport Co., Manchester, O.
Suiter, I. L., Suiter Material & Transport Co., Manchester, O.

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PROGRESS IN THE CRUSHED STONE INDUSTRY

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JUST as it is well for the individual to pause in introspection from time to time, so is it important and even vital for an industry to resort to critical self-examination. How accurately is it dovetailing into the general scheme of things as they now exist? What events are shaping themselves to influence its future position and what steps had best be taken in the light of the relevant facts? Wherein does progress lie? No better opportunity exists during the year than at our annual gatherings for our industry to think collectively and discuss those problems which affect it in its entirety and it is my purpose to bring before you some of the matters which seem worthy of your earnest consideration.

Fundamentally, the crushed stone industry exists because it is performing a service useful to mankind. Were its service not needed, the industry could not long survive and as its usefulness grows or declines, so will the industry be affected in like manner. An industry should survive and prosper only to the extent to which it is capable of supplying human wants efficiently and economically. In a broad general way, therefore, it would seem that progress lies in the development of the usefulness of the industry to the highest standpoint commercially practicable. The question then naturally arises—what constitutes usefulness and along what lines is development needed to make for greater usefulness? To answer this question let us review a few of the problems with which crushed stone producers and users are confronted and let us discuss what might be done in the light of our present information.

General Considerations

Crushed stone, taken as a whole, with exceptions here and there, is the most expensive aggregate to produce of all the coarse aggregates and the price which must be obtained to continue a profitable business must be based upon value to the consumer. It should be quite apparent to crushed stone producers that they must maintain themselves in a position in which they can always justifiably emphasize the superior quality of their product. To that end it must follow that every means possible should be used in production to make for as high a quality of crushed stone, within commercial limitations, as human ingenuity can devise. It is not sufficient that stone barely pass the engineers' specifications; it must be the best material economically and commercially producible within the specification limits. Let us consider this and other matters further as they are related to the several uses for stone.

Crushed Stone for Concrete Roads

There is one outstanding quality that road concrete should possess and that is uniformity. If any one of a number of factors varies, uniformity cannot be attained. Should the grading of the aggregate vary, the concrete will not be uniform, and that is one reason why plants producing aggregates commercially are best able to supply the kind of aggregate most desired for concrete roads and why, on the other hand, aggregates produced by temporary plants with inadequate equipment and without any attempt at uniformity of product fail so miserably in producing good results. Progress in the crushed stone industry will require untiring efforts by all producers to do all in their power to have their stone run uniformly in grading and quality in every batch of concrete.

I am well aware of the contention that segregation of size is inevitable with almost every handling operation, but this contention must not be accepted as final without a strenuous attempt to overcome this evil. Graded stone like other aggregates falling in a single stream undoubtedly separates to some extent, so that the coarse material runs to the outside and the fine material remains closer to where it was deposited. When cars are loaded from a single, central spout, naturally a zone of fine material is produced along the central portion of the car, and the outside portion is deficient in fines. The simple expedient of dividing the stream so that it falls into the car in several streams has already been suggested as a possible means for at least partially correcting this difficulty. There are still other schemes of almost equal simplicity that should at least be given a trial. Again, when the car is unloaded and stock-piled by "coning," very bad segregation takes place and the stone producer is very severely penalized by this inexcusable practice on the part of the contractor. The producer should make a point of insisting that his material be stock-piled in the proper way to prevent segregation. His interest in his material should not cease with the loading of the cars at his plant; it must extend clear to its use in the concrete. Stock-piling in shallow, horizontal, superimposed layers should be insisted upon and the formation of a stock pile by dumping the material in the center, thus building up a cone, should by all means be discouraged.

Attention is called to the suggestion which has frequently been heard and which recently has come into practice,—that of shipping the stone in at

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least two sizes to be later combined at the job in the proper proportions. Your earnest thought and discussion should be given to this proposed practice at this time. From the producers' standpoint it would simplify production and eliminate trouble from segregation. On the other hand, more space would be required for the extra stock pile required on the job, an extra hopper and measuring device would be necessary and the expense of handling would be greater. In other words, there might be greater expense to the contractor which would be reflected in his bid price. This would be offset to some extent by the higher yield of concrete obtainable due to the possibility of better grading and by greater uniformity in strength which should result in more economical future road design. Likewise the workability of the concrete could be improved due to the uniformly better grading. The slightly additional expense to the contractor for equipment would be spread over a number of jobs thus making the offsetting economies and benefits all the more worth considering. This possibility deserves more and earnest study.

Grading of Stone for Highest Yield of Concrete and Greatest Workability

Crushed stone will be made a more useful material in concrete the better it is graded to promote the greatest possible workability and the greatest yield of concrete for a given amount of cement. Specifications for stone generally are written in such a manner that a rather wide variation is allowed in intermediate sizes and this is quite proper, for practical contingencies of production must thus be recognized. However, it is vital to the stone producer that his material be highly regarded by both the contractor and the engineer. The contractor will welcome stone graded in such a manner that the concrete will be easily handled, worked into place and finished. He wants workable and not harsh working concrete. Also, he would welcome stone graded in such a way that the highest volume of concrete will result for a given amount of cement. The engineer also would like stone of this grading for a much smoother job will be obtained. Moreover, a stone graded to suit the requirements of high concrete yield and workability is also generally best graded for strength. Not a great deal of study has been given to the question of the best grading of stone for use in concrete and much good should come from properly conducted tests along this line. I feel that it would pay the crushed stone industry manyfold if they would enter earnestly and intensively into such investigations.

Everything possible should be done in the grading of crushed stone to make for the highest yield and the greatest workability of concrete and uniformity of grading from day to day is essential. To accomplish this result will require study of production methods and eternal vigilance and knowledge of his product on the part of the producer, supplemented by research by the industry as a whole.

Proper Tests for Road Concrete

It has been pointed out a number of times that when concrete roads fail, almost invariably failure is due to the lack of cross-breaking strength of the concrete and not to its lack of compressive resistance. Concrete is, roughly, ten times as strong in compression as in direct tension. The bending stresses in a concrete road created by passing vehicles are just as high in tension as in compression and as the tensile resistance is only one-tenth of the compressive resistance, it is evident that failure must occur in tension. The quality of road concrete should therefore be judged by its resistance to a test which will cause the concrete to fail in tension rather than compression, and the cross-breaking test is a test of that character.

Crushed stone producers should be concerned in seeing that concrete for concrete roads is tested by the cross-breaking or beam test, rather than by the compression test, primarily, because it is the logical test for this purpose. Moreover, it is one which is much more likely to demonstrate the beneficial effects of the mechanical bond of the rough surface of stone aggregate with the mortar. Information is badly needed on the influence which the surface texture of aggregates has on the cross-breaking strength of concrete and much investigational work should be done along this line.

Repeated Loads on Concrete

Concrete roads are subjected to hundreds of thousands of repetitions of tensile stress in the course of one year, and it is not unreasonable that the characteristics of the aggregates will have a great deal of influence on the resistance of concrete subjected to repeated loads. In other words, it is quite possible that although concretes made with aggregates widely different in character might have the same cross-breaking strength under a load applied once, vastly different results might be obtained if these concretes were first subjected to thousands of repetitions of smaller loads which, although not large enough to cause immediate failure, might have a considerable effect on the release of the mechanical bond between the aggregate and the mortar. Such repeated load investigations would throw light on the question of proper concrete road design depending upon the characteristics of the aggregate.

In connection with the question of the bond between the stone and the mortar, there is one phase of crushed stone production which has given a number of producers a great deal of trouble during the past and that is the question of the effect of a coating of stone dust. Many cars have been re-

jected during the past year because the stone either contained dust or had a coating of dust. The contention of some engineers has been that the presence of a film of dust might be harmful due to possible destruction of the bond between the stone and the mortar and to the possibility of the dust rising to the surface during the finishing operation, thus causing a weak surface layer subject to scaling under the action of traffic and frost. Other engineers just as strongly and honestly believe such contentions are erroneous especially in these days of relatively dry, plastic mixes free from excess water. Producers should be fortified with definite knowledge on this point. It is a vital one which cannot be ignored and which cannot be settled by argument and contention. Your production methods in the future, in part at least, are involved with the dust question and that is why it is so important that we be forearmed with definite knowledge so that we might proceed intelligently. In the meantime some of your troubles will be avoided by doing your utmost to keep the dust down to a low percentage.

Progress for the producers who are supplying aggregates for concrete road construction would seem to lie, therefore:

1. In their making an effort to produce aggregates graded to promote the highest yield and highest workability.
2. To produce aggregates as clean as possible from a commercial standpoint.
3. To lend their support to the conduct of investigations aimed at:—
   a. Throwing light on the question of proper gradation.
   b. Obtaining more information on those factors leading to the highest cross-breaking strength.
   c. Investigations on the effect of repeated loads on concrete beams.
   d. Investigations on the effect of stone dust.

The matter of supplying stone in separate sizes to be later combined in the proper proportions for concrete should also be given careful thought as this is a matter which shows signs of activity at the present time.

Flexible Types of Roads

In connection with roads of the flexible type, including macadam and bituminous concrete, our progress seems to lie in studies which have now been instituted to improve the usefulness of these types. There is no question that roads of the flexible type have demonstrated their usefulness, particularly where care has been taken to provide good subgrade support and where careful attention has been given to the essential details of construction. It is felt, however, that investigations will disclose a means for making these types even more satisfactory than they are at present and your support is needed to lend encouragement to these investigations for their improvement.

Developments which are of rather recent origin in maintenance of secondary roads should also be of interest to you. The so-called "salting down" method of dry maintenance of earth roads is one practiced where large mileage of secondary roads must be maintained as the more durable types are being built. In this process, the roads are covered with a mere carpet of small size stone which is kept in a smooth condition by daily dragging. Such a surfacing is a vast improvement over the ordinary earth road and should furnish an outlet for small size stone, particularly for use on lightly traveled roads. The so-called "retread" method of construction is also an important maintenance measure. This method consists of the use of a thin layer of approximately three-fourths inch stone treated with cut-back bituminous material, then dragged for several days and either rolled or compacted under traffic. Excellent riding surfaces are obtained and the result in general is highly satisfactory. Both of these maintenance measures should furnish a good outlet for smaller size material.

There are a number of problems in bituminous macadam construction which remain to be solved in addition to the matter of cross-section design. One of these involves the determination of the proper size of stone to use for maximum stability of the surface course. It has been claimed, for instance, that stone from two to three inches in size gives better results than stone from one and one-half to two and one-half inches. Again, the maximum size of stone in the base and the proper construction of the base furnishes room for investigation. Stone as large as six inches in diameter is being successfully used in macadam base construction. Surely progress of the industry lies in ascertaining the facts which will make for the improvement of roads of the flexible type as well as improvement in concrete roads. It should go without saying that stone producers will benefit themselves by turning out material of the most uniform quality, so far as grading and cleanliness are concerned for all types of bituminous construction, just as in the case of concrete aggregates, and to obtain proper adhesion of bituminous materials, cleanliness also is quite essential.

Progress here lies:

1. In the development of the bituminous type to render it even more suitable for present day needs.
2. In case to supply uniformly graded and clean materials.

Building Construction

Stone for building construction in some cases has suffered in its competition with other aggregates. This in part has been due to the failure of engineers to recognize a very important principle

in concrete proportioning. It has been the custom, and still is to a very considerable extent, to arbitrarily specify the proportions for concrete without any regard whatsoever to the final result desired and without regard to the characteristics and grading of the aggregates being used. If the sand happens to arrive on the job in a dry condition, the concrete is much more likely to be plastic and free from honeycomb after the forms are removed than results when the sand is quite wet. The reason is that moisture swells sand sometimes as much as forty per cent, and consequently when the sand is wet and the proportions are stated by volume, far too little sand enters the mixture and a harsh working concrete results, difficult to surface. There is absolutely no reason why crushed stone concrete should not always be entirely suitable from the standpoint of workability. Stone producers can do their part by paying careful attention to the grading of the stone and also by insisting that the engineer recognize the phenomenon of the bulking of sand due to moisture, so that sufficient sand will be used to produce a workable mix. These matters have been discussed a number of times and are of very vital importance to the crushed stone industry.

The fire protective features of most types of crushed stone aggregate have not been emphasized sufficiently by producers in their competition with other aggregates. A discussion of this subject has already been given in the September, 1926, issue of "The Crushed Stone Journal" and a full discussion of it is to be found in the report of the Committee on Fire Resistance of Concrete of the American Concrete Institute published in its 1925 proceedings.

In building construction immediate progress for stone producers lies:

1. In producing uniformly well graded stone for the highest yield and workability of concrete.
2. Insisting upon proper concrete proportions which will insure the use of sufficient sand in the concrete mixture so that the concrete will be workable and easily finished.
3. Emphasis on the superior fire protective nature of most crushed stone aggregates.

Concrete Units

Unquestionably, a larger market is developing for the use of concrete products of various kinds and such products furnish an outlet for stone screenings, including the dust. Tests have shown that stone screenings rank among the highest for producing concrete products of very high grade and this fact having been demonstrated there remain to be developed new uses for concrete products. As an illustration of a new use for concrete blocks, there might be cited a development noted in Salt Lake City. Here concrete slabs approximately four feet long by one and one-half feet wide and four inches thick are laid longitudinally on each side of the street car tracks. Apparently they are entirely satisfactory and are eliminating the roughness which develops adjacent to car tracks when other types of pavements are used.

Studying Producing Methods

Engineers invariably specify the size of stone in accordance with laboratory screens supplied with square or with circular openings. The stone is produced at the plant either with revolving or vibratory screens, in some cases with square and in other cases with round openings. No matter what type of equipment is used in producing the stone, it is supposed to pass the requirements for grading stated in terms of laboratory screens having a given size and shape of opening. It would seem necessary then, that every plant be equipped with laboratory screens and it should be the duty of some one individual to keep a continuous check on the size and quantity of material of the various sizes being produced, for only in this way can there be any assurance that the materials are being actually supplied in the manner desired. The frequency of testing will, of course, be governed by circumcumstances but the point is that sufficiently frequent testing should be performed so that the producer will have full information on the gradation of his product stated in terms having significance to the user, in terms of laboratory screens.

A study of your product in an effort to improve it should be a continuous process. Oftentimes through a slight change in the method of manufacture a much more suitable stone might be produced, perhaps by the elimination of more of the dust, perhaps by production of more satisfactory grading. An improvement in the now seemingly impossible might even be accomplished, namely, the elimination of segregation. I am firmly convinced that, by and large, higher and higher quality must inevitably result in that greater usefulness which will insure progress for the crushed stone industry.

Necessity for Obtaining Facts

There are many facts to be learned in connection with the characteristics of crushed stone before definite steps can be taken to develop its field of usefulness. A few of the questions involved in your progress have already been mentioned and there are a great many more of equal importance to the industry which can be solved only through the performance of proper investigations.

To my mind, the whole matter might be summed up in the statement that your entire progress is in your own hands. It depends upon your development of the usefulness of your material on a quality basis and that development, in large measure, must be founded upon facts which you can discover in connection with your own production.

RESEARCH AS AN AID TO EFFICIENCY

By Oliver Bowles*

DIFFERENT interpretations are applied to the term research. Some investigators reserve the term for basic truths, fundamental principles such as relativity or the law of gravitation. Webster defines research as "careful or critical inquiry or examination in seeking facts or principles." I am inclined to give the term this broader interpretation which includes the application of established principles in practical ways, the utilization of knowledge gained in one field for the solution of related problems in new and untried fields, or more generally speaking the search for facts that tend toward human progress. In such an interpretation the practical side of research is emphasized, it is not so much an establishment of fundamental principles as it is the application of principles and knowledge to the every day problems of the operator. Therefore in using this term "research" I have no intention of wearying you with complex disquisitions that leave the mind confused, my intention is rather to illustrate with examples the value of applying to your problems the knowledge that has been gained by general studies of your industry, or by studies of related industries.

The Nonmetallic Minerals Experiment Station of the Bureau of Mines which I represent has little hope of establishing any new and fundamental truths that will startle the world; our hope and expectation is to take the principles of physics, chemistry, geology and mineralogy together with all the accumulated knowledge of mining and metallurgy in all their branches, and apply them to the problems of the nonmetallic minerals. Such studies are essential to the prosperity of any industry. Evidence that the National Crushed Stone Association has recognized this fact is to be found in the recent establishment of a Bureau of Engineering as a function of the Association. I am heartily in favor of this movement and as its work is closely allied to that of the Bureau of Mines I hope to work in close cooperation with the engineering bureau.

Many operators are reluctant to try new methods or to introduce innovations because the proposed changes have not come within the scope of their own experience. Experience is undoubtedly the most thorough teacher, but it is likewise one of the most expensive. While operators may with due diligence work out fairly efficient practice within the narrow confines of their own quarries and crushing plants, undoubtedly greater progress can be made with less expenditure of nerve and energy by those who reach out and benefit by the experience of others. To many operators this process of reaching out to grasp the ideas gained in other fields is difficult, because so much time and attention are required for their own individual operations. In this age of publication and travel some opportunity is afforded to broaden one's knowledge by attendance at conventions such as this, by the reading of technical literature which contains invaluable information, and by occasional travel to observe the operations of others. Valuable as such experiences are I believe there is still a place for a government bureau, an impartial tribunal that can work out fundamental principles, that can analyze conditions, that can by observation, study or experimentation, determine facts and compile data of value to the industry as a whole.

The type of service performed by the Bureau of Mines for the nonmetallic industries is best indicated by actual illustrations. About two years ago a call for help came from the fluorspar district of Illinois and Kentucky. The companies were finding that they were suffering heavy losses of fluorspar in the tailings from their mills. The New Brunswick Station cooperated with the Rolla, Mo. station in a study of this problem, because the latter station specialized in milling problems. The accumulated knowledge gained in studies of milling lead and zinc ores of the Tri-State district was applied to the fluorspar problem, in consequence of which several of the larger mills remodelled and provided with equipment developed by the Bureau, are now obtaining a much better recovery, and saving thousands of dollars worth of mineral that formerly went to waste.

Another example may be cited from the slate industry. A general study of slate quarries by the bureau brought out the fact that present methods of cutting slate with channeling machines is very wasteful, as it shatters and destroys the good slate for a distance of one to two feet on either side of the cut. The wire saw is used to some extent in Europe as a substitute for channeling machines, and its advantages were so obvious that the Bureau took steps to introduce it in America. Complete equipment was purchased from Belgium through the New Brunswick station and comprehensive tests in the quarries of Pennsylvania are now being made in cooperation with slate companies and under the direction of a bureau engineer. Accurate records will be kept of equipment cost, rate of cutting, power, maintenance, expense, etc., in comparison with equipment now in use, and a report covering our findings will be made available to the entire industry.

The above examples are in themselves of no

*Presented before the Tenth Annual Convention of the National Crushed Stone Association on January 20, 1927.

particular interest to crushed stone operators, as they pertain to other industries. They are briefly mentioned merely to illustrate the type of service that we try to give. However I have another illustration that comes within the field of experience of some crushed stone operators, and may in the future affect many more.

In visiting many limestone regions over a period of years the writer was impressed with the growing necessity for underground operations as contrasted with the open pit method so commonly used. Through restricted surface outcrops, steep dip of the desirable beds, or increase in depth of overburden, quite a number of limestone quarry operators are finding it advantageous to mine their stone and leave the overburden undisturbed. Over 60 limestone mines are now in operation in America. Realizing that underground work is new to most quarrymen, about two years ago I obtained the services of a consulting mining engineer familiar with both metal mining and limestone mining, and assigned to him the task of preparing a complete report on the advantages, disadvantages, methods, controlling conditions, safety and cost of underground limestone mining. The results of his study brought to light certain facts of interest to all quarry operators. He found for example that, contrary to current belief, underground mining costs are not greatly in excess of those for open pit work, the average difference being about 30 cents a ton, and this 30 cents may easily be saved in absence of a stripping charge. Also it was found that laborers, when they become accustomed to it, generally prefer to work underground, and that when operations are properly conducted the mine is just as safe as the open pit. The report as Bureau of Mines Bulletin 262 should be available for distribution within a month or two. This problem is a good example of the utilization of accumulated experience, for we have combined the costs, the methods, and the experience not only of all branches of the limestone industry (cement, lime, crushed stone, and flux), but have added thereto the knowledge gained in metal mining in so far as it is applicable.

Another problem now in progress is a study of the metallurgical limestone industry. About 25 million tons of limestone are used annually in furnace work, chiefly as flux in the smelting of iron ores. Limestone producers as a rule have little knowledge of the way in which their stone is used, its action in the furnace, and the effects of various impurities. Metallurgists on the other hand have very inadequate knowledge of the limestone producer's problems, and at times unknowingly inflict unnecessary hardships upon the quarryman. The purpose of the present work is to co-ordinate all branches of the fluxing stone industry bringing to both producers and consumers all the information available both on the preparation of the stone and on its use.

In the broad definition I have given to research the interpretation of accident statistics, and the lessons to be derived therefrom fall properly within the field of safety research. I greatly regret that W. W. Adams of the Washington office of the bureau who has charge of accident statistics could not be present at this meeting. Both he and I are willing to cooperate in any way we can with your Safety and Welfare Committee in an effort to reduce the hazards in the crushed stone industry. We have already met with this committee in conference in New York City. A detailed analysis of accident figures which Mr. Adams has promised to make will be very helpful in determining the relative importance of various hazards and thus making it possible to direct remedial measures toward those that account for the greatest number of accidents. A feature that is quite obvious but which I wish to emphasize nevertheless is that figures cannot be analyzed unless we first have the figures. Your part is to supply Mr. Adams with as complete accident statistics as you can on the forms which he will provide. This is essential if any cooperative work of value is to be accomplished. The first step is to get the figures, that is your part; the second step to analyze and interpret them, that is Mr. Adam's part; and the third step is to study ways and means of reducing the hazards which the statistics reveal. That is your task also, but at the same time it is one in which I believe the Bureau of Mines may be of assistance to you. An important part of the bureau's work relates to safety problems. In our nonmetallic studies safety is kept very much in the foreground. I have in mind certain definite ways in which we could assist in your safety program, as for example, in making a revision of Technical Paper III, "Safety in stone quarrying," to make it particularly applicable to the crushed stone industry. Other ways will no doubt appear when an analysis of your accident records has been made.

One other feature of this broad field of research that I wish to emphasize at this time is the study of reserves, future development, and future methods of operation. Times have been prosperous for the crushed stone industry, and every effort has been directed toward greater and greater production. There is no doubt much wisdom in the proverb about making hay while the sun shines, but there is another proverb which reads "In times of prosperity prepare for adversity." Unfortunately I have found that when a nonmetallic industry is unusually prosperous there is little sympathy or cooperation toward research into better methods or equipment, but when a slump comes, operators will stop and listen. This condition should be reversed. The time of greatest prosperity is the time to look furthest ahead, to plan broad development, to aim toward cheaper production, and the most complete utilization of rock reserves. Questions before the

crushed stone quarryman, are, what tonnage of stone have I available in the ground? What will be the condition of my quarry five years hence? Will operating costs be lower or higher? Can I follow my present methods, or will change in depth of overburden, dip of beds, or some other factor necessitate a radical change in plan of operation? The answers to these questions may have a definite influence on present operations.

Another factor that demands alertness and foresight in planning future operations is the rapidity with which changes are made in modern industrial practice. The past 10 years have seen more changes in industrial equipment and methods than in a period of several hundred years preceding. This is an age of innovations and inventions, and the rapidity of change accelerates as time goes on. It may be claimed that conditions are fairly stabilized in the crushed stone industry, that changes are not as pronounced as in many other industries. While this may appear to be true, profound changes are affecting many branches of mining and their influence should be felt on your industry.

The rapid changes of today have an influence even on the definition of terms. The term amortization in relation to equipment has been defined as a sum set aside each year sufficient to replace a worn out machine with a new one. Thus if the life of a machine is estimated at 10 years, the annual amortization charge would be one-tenth of its first cost. The rapidity of change in equipment through invention and changes in methods to which I have already referred make it necessary to modify this definition. It is no longer safe to base the amortization charge on the life of the machine alone for the demands of progress may require that the machine be scrapped and replaced by some other type long before it is worn out. Let us assume for example that a quarryman purchases a railroad or caterpillar steam shovel. He may find five years after its purchase that he is forced to abandon the open pit and resort to underground methods which require small type shovels or hand loading. The large shovel will probably be sold at a great sacrifice though only half worn out, and its real amortization period would be five or six years rather than 10. Thus the factor of obsolescence is becoming increasingly important, and the tendency is to shorten the effective life of quarry equipment. The clearer the vision one can obtain of his future operations the less will be his losses from this source. The Bureau of Mines claims no prophetic powers, but its increasing knowledge of progress in all branches of mining may be of some assistance in working out problems of present or future development in the crushed stone industry, and whenever our equipment and personnel may be of assistance, they are at your service.

Explosives Investigations

The Bureau of Mines, Department of Commerce, is studying the determination of the fundamental constant of explosives materials, including solubility, specific heats, hygroscopicity, heats of fusion, etc. Much of this information is not available, and is needed in determining safe methods for handling explosives. During the year a survey has been made of existing data on thermo-chemistry of nitro-explosives and a number of new values determined.

In the purification and separation of explosive compounds, solvents are important and, accordingly, as new solvents are developed their action on explosive compounds is studied. Glycol diacetate showed promise of being valuable in the purification of high explosives, and as very little fundamental data were available in the literature, the chief physical constants were determined and its solvent value studied.

The purpose of another investigation is to determine the structure and properties of the nitrosites which have been patented as initiators of explosion but about which little is known. Investigation of Bis (trimethylethylene nitrosate) showed that the compound exists in two crystal forms that are transformable and exhibit a new type of stereoisomerism. The Bureau is also studying the cause of deterioration of Cordeau-Bickford fuse containing TNT purified by the "Cellite" process.

A study is being made to determine whether breakage of steel, caused by an explosion, can be identified by an examination of the Neumann Bands produced, and also to what extent metal is weakened by Neumann Bands. It is planned to determine how heat treatment affects the characteristics of Neumann Bands, and to what extent the physical properties are changed by the presence of Neumann Bands. This investigation is in cooperation with the National Research Council.

Properties of Gelatin Dynamites

The purpose of an investigation being conducted by the Bureau of Mines, Department of Commerce, is to compare the properties of gelatin dynamites made from nitroglycerin and those made from a mixture of nitroglycerin and ethylene glycol dinitrate. The use of ethylene glycol dinitrate as a low-freezing ingredient has made desirable a study of the ageing properties of gelatin dynamites containing this ingredient. Samples of typical gelatins are being made up in pairs, one containing ordinary low-freeze nitroglycerin and the other identical except for the substitution of this ingredient. At 1, 3, 6, and 12 months from date of manufacture these will be examined for consistency, sensitiveness to explosion by influence, and rate of detonation, unconfined, primed with 40 per cent straight dynamite, and confined in Shelby tubes.

DESIGN OF SAND AND GRAVEL PLANTS

By Frank M. Welch,

Chief Engineer, Greenville Gravel Corporation*

COMPARATIVELY speaking, it has been but few years since the gravel industry emerged from the experimental stage. Not long ago, the average engineer and architect, because of his limited knowledge and the lack of stability in the gravel business, invariably specified crushed stone. Although increased usefulness and added merits of gravel aggregate are constantly being developed, the era of guess work has long since ended, and the production of gravel has become one of the basic industries. Each year, it is taking a more prominent position in the front rank.

The results of the proven reliability and superiority of our products are the hundreds of important concrete structures which have and are being built throughout the country with gravel aggregate. When, after careful study by the most outstanding engineers, gravel aggregate is used in the construction of such engineering monuments as the Big Four bridge at Sidney, Ohio, the new union station at Cleveland, the A. I. U. building at Columbus, and the new Book Tower Building in Detroit, which will be the tallest building in the world, we are at once reminded of the grave responsibility with which we producers are confronted. Our industry has arrived at a point where we must not and need not experiment to any great degree either in the production of our material or in the construction and design of our plants. The subject which you have allotted me, in short, is "plant design." In fact it is so short that it is very broad, covering a great deal of territory and permitting a lot to be said. I am, therefore, only going to hit a few of the high spots, and discuss some of the more recent developments in modern practice.

Speaking of broad subjects, I am reminded of many inquiries which I have received in years past. These inquiries usually come from land owners who have found some gravel on their farms, and would read something like this: "How much does a gravel plant cost?" Rather broad subject to answer. When I was with the Webster Manufacturing Company, I got up a printed questionnaire which I sent out in reply to such vague inquiries. If two-thirds of these questions were fully answered, I was much better prepared to give an intelligent estimate regarding the probable cost of their proposed plant, or else to advise them to invest their money in some other way. During my later years, since associating with the Greenville Gravel Corporation, and since I have embarked as a consulting engineer, it seems to me that I have either been catering to a more intelligent clientele, or else the general public have begun to realize that there is no such thing as a "hand-me-down" sand and gravel plant.

They have learned that there are so many prevailing conditions, such as the nature of the deposit, topography of the property, shipping facilities, market requirements, proximity to market, competition, and so forth, which govern the type and design of every link in the operation, that such a thing as a standard design is not practical.

In the dozen or so plants of the Greenville Gravel Corporation one would think that at least two of them would be duplicates. They are not. Each plant is designed to fit all the conditions at hand. It is true that there are certain mechanical units and parts of units which are standard and which enable us to keep standard repair parts on hand at our main shops in Greenville. Even were the environments identical at two of our deposits where plants were to be constructed, unless both plants were built the same year, the varying markets and the constant development of better methods would doubtless alter at least several of the respective details in the two plants. Bearing in mind all the gravel plants in the design of which I have collaborated, including these of our own organization, those which our consulting engineering department has piloted, and those which I built before coming to Greenville, I have yet to find an instance where the drawings for one successful plant were suitable for another.

I am going to interpret my subject of "plant design" literally, by discussing only the plant proper. We ordinarily consider that the plant proper starts at the receiving hopper at the foot of the belt conveyor, elevator, or whatever unit is employed to raise the raw material to the top of the building, and that it ends at the loading gates. We are all so familiar with the belt conveyor and bucket elevator for the initial lift that I will waste no time discussing these units except to review briefly our experience with various types of feeders.

Feeders, as you know, are used for maintaining a uniform and constant flow of raw material onto the conveyors or elevators from the receiving hopper. In the early days of our industry, the more progressive operators, who were constantly on the lookout for labor-saving devices, such as automatic feeders between their receiving hoppers and conveyors, tended to follow the standard practices successfully used in the coal fields. Therefore, the earliest attempts to eliminate the necessity of a man at the hopper gate consisted of the reciprocating feeder which proved to be a step in the right direction. The next advancement was the steel

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apron feeder, which produced a somewhat more continuous flow than did the reciprocating outfit. Both of these units worked successfully in gravel as they did in coal, but unlike the coal, the gravel and sand ground them out rapidly. A plant with a fair annual production would wear out either of these types in a season. We finally developed the rotary feeder which cost less money in the first place, lasted several years, required less horse power, produced a uniform feed, and in general proved to be the final answer. This, like the other types of feeders, drives from the foot shaft of the conveyor or elevator.

The next step in the flow sheet, that of elevating the raw material to the top of the plant, has produced some interesting problems during the last few years. This was especially true where the deposit lay all or partly under water and pump boats were used for excavating. It was soon found inefficient to pump the material all the way to the top of the plant except on very low and limited operations. It was further found necessary, in order to elevate the wet material on a belt conveyor, to install the conveyor at a much flatter slope, which meant lengthening it considerably. Even then if much water remained in the sand and gravel, the speed of the conveyor had to be nearly doubled to properly retail the material. Likewise the bucket elevator showed excessive wear and tear if working in water, even when a very expensive type chain was used.

Our management conceived the idea of elevating wet material to the top of the plant with a balanced skip hoist. Knowing that such equipment was used extensively and successfully in the mining fields and at blast furnaces we consulted concerns and engineers experienced in skip hoist designs. We requested estimates on complete units to suit our requirements, but in spite of all we could do, these estimates persisted in hovering around $30,000.00 to $40,000.00. As such a figure was prohibitive and realizing that a couple of 5-ton steel cars or skips could be built and hauled up and down an incline for less money than that, we timidly set out to design our own skip hoists.

We built the first one at a cost not much different than the cost of a belt conveyor with its drive and trestle, to do the same amount of work. When it was completed we warned everybody to stand back, turned on the juice and threw in the switch for the first time. It worked. Aside from a few minor perfections, we have installed several skip hoists since, just like the first one. We had purchased automatic electric track limit switches to insure against the skips not stopping at the top just when they should, or in other words, to partly eliminate the personal equation of the operator. Somehow, in the first couple of installations, there was no room to install these safety devices and they were left out. However, since one of our 5-ton skip cars landed over in the middle of a plant on top of a screen, we have found or made room for the track limit switches.

The skip hoist compares very favorably with the belt conveyor operation handling an equal tonnage. It requires a large motor, but the load is intermittent, leaving the power bill about the same. It requires one more man to operate, than does the belt conveyor, but this is counteracted by the low maintenance cost. The first cost is not much different. One of our district plant managers, who has had plenty of experience with both, states that whether wet material requires it or in handling dry material from a steam shovel, he would as leave, if not prefer, the skip hoist for the initial elevating unit rather than the tried and true belt conveyor.

At this point in our flow of material, the question arises as to the best location of the crushing equipment, if any is required. Some operators prefer to complete their scalping and crushing before elevating the whole to the top of their plant where the final screening is done. Their reason for this course is that it eliminates the elevating of their oversize material twice. I think there are three following arguments which considerably offset the above reasoning:

First, while the double elevating of the coarse product is being only partially eliminated, a double elevation is required of all the sand and marketable gravel a distance about equal to the heighth of the crusher house.

Second, it is less expensive to build the crusher room as a part of the main plant, than it is to erect a separate building for the purpose.

Third, the separate crushing unit precludes the possibility of selling any separate crushed material, without involving additional and costly loading facilities.

There are other technical reasons, which I will not now take the time to analyze, why it is more economical from both standpoints of first cost and of daily operation to carry all the material to the top of the main plant with the initial elevation and before any crushing is done. All of our operations are constructed this way. At one or two of our plants, however, where boulders of considerable size in large quantities occur in the deposits, we have installed a large low type of jaw crusher, adjacent to the receiving hopper and directly over the belt conveyor. The top of this crusher is slightly lower than the top of the receiving hopper. Boulders, which are too large to pass the rail grizzly on top of the hopper, can readily be pushed into this crusher by the man who dumps the pit cars. This process is greatly facilitated by sloping the hopper grizzly bars slightly toward this crusher or breaker. The unit is really a preliminary breaker, which merely serves to crack the

larger boulders before dropping them on the conveyor belt.

Now that we have our raw material safely in the top of our plant, what are we going to do with it? The answer depends considerably on what our biggest customers want us to produce. We cannot cater to the whim of every indiscriminate user of gravel and sand that comes along and yet we can arrange our screens to permit a flexibility of production, which will accommodate a great variety of specifications. I am not going to dwell upon the superiority of various types of screens but I will tell you of some of the principles which our organization has quite successfully followed. We, of course, wash our material first and rewash or rinse it while screening. Our oversize passes down to crushers on concrete foundations below and is re-elevated for further screening. Our screening process is in some respects the same as most producers follow, but in some respects quite different from many.

When the various grades of material roll from our different perforations, they all come from the screen at about the same point instead of at remote points. In other words the various sizes are so close together in adjacent steel spouts, as they come from our triple-jacketed screens, that by the manipulation of butterfly valves, any mixture in any proportion can be produced. Furthermore, we find that this process very thoroughly mixes the aggregates. It also permits the man in the screen house to watch the products and keep the mixtures uniform regardless of variations in the pit.

The choice of sand settling tanks varies a good deal according to the percentage of sand, market requirements and personal preferences. The automatic type, the hand operated stationary kind, and the mechanically driven tanks all serve their intended purposes or they do not remain long. The mechanically driven tanks, that is, the tanks made long and narrow with the bottoms sloping upwards to above the water level, where the sand is dragged out by a flight or drag conveyor, is becoming quite popular in the larger cities. This is because these machines so thoroughly dewater the sand that delivery trucks do not violate the city ordinances by dripping water on the public streets.

Regarding power, we are now driving all of our operations electrically, purchasing our power from central plants. We have found it most satisfactory to drive each unit in our installations with a separate motor, with the exception of the crushers. By driving all the crushers from a common line shaft we can drive, say, three crushers requiring 50 H. P. each, with a 100 H. P. motor. This is possible because seldom are all the crushers handling their maximum load at the same time. About the only feature which we have left untouched in the screen house on top of the plant, is the subject of washing water. We all have our different problems to solve in the matter of supply and application of water and the solutions must be worked out to suit each operation.

Passing on from the washing, screening, and crushing operations, the question of type, size, and arrangement of bins underneath the screens opens up an array of designs. To start with, some operators prefer side loading bins, whereas others pass their railroad cars or trucks underneath. In our plants, we do all our loading underneath because this method reduces the total height of bins having the same capacity. It further permits the use of three or four loading tracks and more flexibility in the machinery layout above. There is scarcely any difference in the respective costs of the two types and the only argument against the overhead bins is the greater leakage of water through closed gates into cars and tracks below. However, if the washing water is properly distributed in the screens above there is very little water leakage through the gates except under the sand bins.

Speaking of three or four loading tracks some operators feel that putting in so many tracks is an unnecessary added expense. If you will consider that you must have so much track storage room for your empty and loaded cars, and that you must build a grade for these tracks, you will find that you can build your total length of track required cheaper side by side than by stringing it out half a mile or more. For a plant of any size at all, the loading is greatly facilitated if three or four loading tracks are available and a plant so constructed, permits of considerably more flexibility in the arrangement of the machinery above the bins and in the flow and handling of various grades of material.

Returning to the subject of bins will say that our company has adhered to the policy of little or no bin storage. Outside of one plant which we built during the extreme car shortage period caused by the war, our plants are all designed to load our main commodities, such as railroad ballast, concrete pebbles, concrete mix, sand, and so forth, direct into cars from our screens. Of course we have small bins of enough capacity to permit the shifting of cars and we usually have about two bins which hold a car and a half apiece. These larger bins are to receive by-products such as roofing gravel or separate crushed material which are made slowly and which are not loaded until at least a carload is in the bin.

When speaking from our general standpoint, however, I am considering conditions entirely different from an operation located within or near the limits of a large city, where all or a large part of the shipments are by trucks. Such a plant caters to both wholesale and retail trade and must be equipped with extensive storage facilities such as retail trade demands. The larger the bins, the

(*Continued on page 104*)

VIBRATIONS CAUSED BY QUARRY BLASTING AND THEIR EFFECT UPON STRUCTURES

By Edward H. Rockwell
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MODERN methods of controlling the effects of well drill quarry blasting have been perfected so as to render any vibrating effects transmitted through the air to be negligible. It is impossible to eliminate all effects of vibrating motion transmitted through the ground although well balanced charges of explosive such that the energy released by the blast is the minimum required to move the rock will reduce earth vibration to the minimum. Some earth vibrations will of course always be present and in cases of explosive charges of amounts from 2000 to 10,000 lbs. of dynamite the earth vibrations can be felt for distances up to two or three thousand feet. People of a nervous temperament are prone to exaggerate these effects to an extent that makes popular description entirely untrustworthy.

The General Crushed Stone Company became interested in a quantitative study of these earth vibrations and their effects on structures with the object of determining their magnitude and effects if any on the units of building construction such as floor joists, foundations, stucco walls, and plaster walls and ceilings.

Upon starting this study, it was soon found that there existed practically no information whatever in regard to the actual amounts of movement and force exerted upon bodies caused by earth vibration. Some work was being done in Japan upon the effects of earthquakes on buildings but even these results were not published in English at the time. It has of course been known for a long time that seizmographs were in use at various universities to measure the earthquake vibration but actual methods of translating the results from these observations into suitable data for determining questions of structural safety were not available and earthquake seizmographs are, of course, too large and unwieldy to be moved about, and are incapable of measuring the rapid vibration and small movement caused by well hole blasting. Might as well use a yardstick to measure the accurate measurements of automobile parts.

It was, however, discovered that two portable vibration recorders had been built and it seemed advisable to secure one of these for experimental purposes in connection with this study to secure records of the actual vibrations dut to earth vibrations. The portable vibration recorders are in reality small seizmographs employing the same fundamental scientific principles as earthquake seizmographs but of a much smaller size and so constructed as to measure and record the much smaller but more rapid vibrations caused by blasting and by moving machinery. These vibration recorders had been used for recording similar vibrations and for determining by comparison the relative sizes of vibrations and their effects upon structures but no actual method for translating these vibration records into quantitative forces or energy values had yet been used.

Mr. Deutsch, a consulting engineer of New York, owned one of these instruments and he was retained to transport his vibration recorder to the quarry and secure records of blasting operations. Such records were obtained in various houses situated from six or seven hundred to eighteen hundred feet from the quarry upon at least five different occasions. Various other methods such as setting up pencils and afterwards groups of different sized steel pins were employed and were found to afford useful information corroborative in nature which will be discussed later.

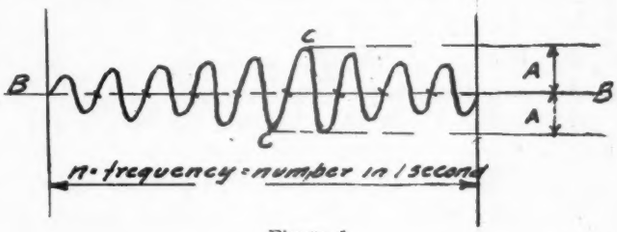

Figure 1

The vibration recorder afforded a considerable amount of information as to the actual amount and rapidity of the movements due to quarry blasting and recorded the information in permanent records. The motion caused by blasting is the same in kind but not in amount to that caused by earthquakes and is called Harmonic Motion. When recorded on a drum it looks like the sketch (Fig. 1) but is, of course, much smaller although actually magnified by the instrument so that its dimensions can be scaled like any drawing.

Forces due to a blast cause actual movements of the ground and objects resting on it, back and forth in three coordinate directions, usually measured parallel to the two sides of the structure and perpendicular to the ground, and the amounts of movement usually decrease as the distance increases, probably inversely as the square of the distance but possibly at a greater rate, even as great as inversely as the cube of the distance.

The rate of vibration wave transmission is prob-

*Presented before the Tenth Annual Convention of the National Crushed Stone Convention, January 20, 1927.

ably approximately equal to stress transmission in the material surrounding the quarry which in rock is about 13,000 feet per second or 2½ miles per second (12 times the velocity of sound in air = 1089 feet per second). The effect lasts only one or two seconds and the waves have a frequency from 10 to 15 per second in the cases examined.

A study of the fundamental facts in Harmonic Motion show that its important elements are the amount of actual movement in one direction from a position of rest called the "single amplitude" (total movement in both directions is called double apmlitude = 2A), which is called A and shown in Fig. 1, and the "frequency" which is the number of complete waves transmitted in one second which is called "n."

There are certain mathematical relationships involved in Harmonic Motion such that a knowledge of the values of A and n enables one to compute what is called the maxium "acceleration" and also to compute the maximum velocity of motion. From the quantities "amplitude," "acceleration" and "velocity" it is now possible to determine the forces acting on structures, the limits of deflection in short structures, and the energy that is present causing stress or tending to tip over objects. As in all structural computations it is also necessary to know size, dimensions, moments of inertia, material, moduli of elasticity, and elastic limits of stress, but these are usually known or can be obtained.

It is useful as well as interesting to know that comparison of earthquake and quarry vibrations show for earthquakes (Japanese)

Amplitude = 1.42 in. n = 1 to 1½ per sec.

Max. quarry vibrations measured.

Amplitude = .009 in. n = 10 per sec.

The earthquake movement is, then, about 158 times as great and one wave vibration lasts 7 to 10 times as long.

The calculated kinetic energy exerted on a residence of ordinary size would be about 400 times as great in the great Japanese earthquake as due to the maximum recorded quarry blast. These figures are not exact ratios of probable stresses in structures but they afford a striking and useful comparison. "Acceleration" may be either positive or negative and is defined as the increase (positive) or decrease (negative) in the velocity per second, during one second and is spoken of as acceleration per sec. per second or acceleration per sec.^{2} and is measured either in feet per sec. per sec., or in inches per sec. per sec.

The fundamental relationships of mechanics expressed in formulas are

$$F = m\ a = \frac{W\ a}{g}$$

K.E. = Kinetic Energy = $\frac{Wv^2}{2g}$ = capacity for doing work.

$$a = 4n^2n^2A$$

$$v = 2n\ nA = VaA \qquad v^2 = aA$$

in which

F = force due to acceleration in lbs.

m = mass of a body = $\frac{W}{g}$

W = weight of body in lbs.

g = acceleration due to force of gravity = 32.2 ft. per sec, per sec. = 386.4 inches per sec, per sec.

a = acceleration in inches per sec. per sec.

v = velocity in inches per sec.

A = single amplitude in inches.

n = frequency = no. of vibrations per second.

The vibration record gives us the value of A and n. From A and n the values of certain other quantities necessary for our purposes can be obtained and are,

F = force

a = acceleration

v = velocity

K.E. = Kinetic Energy = capacity for doing work.

In order to compute the actual stresses in bodies it is, of course, also necessary to understand the principles of structural mechanics including resiliance, the formulas for which are too numerous to mention here.

The usual method of computing the forces acting on structures from earthquake vibration is from the formula given above, i. e.,

$$F = \frac{W}{g}$$

a = force acting on body

As shown in an article published in Engineering News-Record for Dec. 27, 1923, the force F is considered to be equivalent to a static force for the purpose of computing stresses.

It should be remembered however that this is the force acting upon a moving body and is the force which is producing motion and during parts of the vibration is acting so as to increase the velocity of the body. If the period of vibration is relatively great, similar acceleration may produce much higher velocities and very much greater Kinetic Energy in one case than in the other inasmuch as K.E. varies as v^2. Since K.E. = $\frac{Wv^2}{2g}$,

twice the velocity will produce four times the energy and three times the velocity will produce nine times the K.E. etc.

When the velocity of motion is very small and the period also very small as in quarry vibration (max. observed v = .57 inches per sec.) computations for stress from K.E. equations check very

closely results from the use of $F = \frac{W}{g} a$ with F used as a static force.

When the amplitude, velocity and period of time are relatively large as in earthquakes, the acceleration is not necessarily much increased (8½ ft. per sec, per sec, in Japanese earthquake) and is not a proper measure taken alone, for determining stresses or the probable damage. The true criterior for stress or damage is the amount of K.E. generated in the body.

This is shown by the following results on a house 26 x 42 feet in plan, 30 feet high and weighing 160,000 lbs. The comparison is between the effects caused by a quarry blast 1800 feet distant, as measured on a vibration recorder and the effect that would have occurred if subjected to the Japanese earthquake, as recorded on a seizmograph.

The acceleration due to earthquake is only 2.8 times that due to quarry blast but the Kinetic Energy is 448 times as much.

In the above case the stresses caused by the quarry blast were about equivalent to those caused by the total statis force F = 15000# on the house or by a wind of 12#/sq. ft. on the side of the house, and were insignificant in all the units of the building with factors of safety in the frame of at least 50 or 60 and with factors of safety for stucco and plaster of 5 or 6.

These results were checked by computations using the Kinetic Energy equations.

Using the force F for the earthquake would have shown results inside the safe values for all of the building units but the correct use of the Kinetic Energy equation would show the frame probably intact but distorted while all plaster and stucco would be broken and probably destroyed.

Acceleration taken alone is not a safe means of comparison. All the factors, amplitude of motion, velocity of motion, acceleration, period of wave and Kinetic Energy must be used in computing and checking the stresses in the structure.

It is important to know that the conclusions from the vibration recorder records, to the effect that stresses from quarry blasting in the frame, floors, stucco, plaster and other units of ordinary buildings are insignificant and far below those threatening any possible damage, have been independently confirmed by a series of rather simple but unique and extremely interesting experiments with steel pins.

During the early stages of our study and before quantitative results were obtained from the seizmograph records, many simple expedients were tried such as using very full glasses of water and by setting up ordinary pencils. In none of these cases did water spill from the glass nor did a pencil tip over during any of the blasts, which made us rather skeptical about claims that persons had been thrown out of chairs or that dogs had been thrown clear across kitchen floors.

The pencil experiment lead to the use of ¼ inch diameter steel pins from a few inches to fifteen inches in height, which were very carefully made perfectly square on the ends and somewhat concave so as to insure absolutely even bearing. These were set up on hard level surfaces in frames such that in tipping over no pin would tip over its neighbor. These groups of pins were set up in various locations at various distances from the quarry face, on a large number of occasions, and in practically no case over 200 ft. from the quarry did any of the pins fall during a blast, and even at this close proximity only the 15 inch were affected.

After some study, methods of applying the principles of work involving Kinetic Energy were employed such that the amount of energy applied to the pin by the blast was equated to the amount of energy necessary to tip over the pin, and from these equations it was possible to prophesy about what the upper limits would be for acceleration, amplitude and velocity of motion, caused by the blast. For instance if a 15 inch pin tipped over but a 12 inch pin failed to do so then the components of motion would at least be smaller than enough to tip the 12 inch pin, inasmuch as the higher the pin the easier it is to tip it over.

The seizmograph records were checked by the pin experiments to the extent that at one house 1800 feet from the blast, the recorded vibration indicated that the vibration would have been just a small amount less than enough to tip over a 15 inch pin. No 15 inch pin has been tipped over by similar blasts even when closer to the quarry, therefore the seizmograph record indicates vibrations at least as great as indicated by the pins. The check could be made more apparent by showing the computations giving these results.

In general I believe that the pin experiment is highly significant and can be used with confidence when a more accurate record from the portable

	Quarry Blast				Earthquake			
	Acceleration	Velocity	F	Kinetic Energy	Acceleration	Velocity	F	Kinetic Energy
House 26'x42' 30' high Weight= 160,000 lbs.	3 feet/sec²	$\frac{57 \text{ in./sec.}}{100}$	15,000 lbs. 12 lbs. sq. ft.	67 inches	8½/sec²	12 in./sec	42,500 lbs. 34 lbs. sq. ft.	30,000 in.

vibration recorder is not available. In a series of at least five or six experiments with the vibration recorder using up to 10,000 lbs. of dynamite and breaking off quantities of rock up to 40,000 tons the records show a frequency of vibration from 10 to 15 per second with a maximum amplitude of motion = .012 inches and a maximum acceleration of about 4 ft. per sec. per sec.

These results were obtained in a residence 1800 feet from the blast but smaller results were recorded in other houses much nearer and with larger charges of dynamite. These components of motion are theoretically very close to the amounts necessary to tip over a 15 inch pin. Stresses caused by motion of this magnitude are moreover very far inside the safe stresses in building materials. Therefore I am quite firmly of the opinion that reliance can safely be placed on the pin experiment certainly to the extent that any blasts failing to tip over 15 x ¼ inch pine are well within the safe limits of ordinary building construction. It is interesting to note here that the great Japanese earthquake produced 100 times enough energy to tip over a 15 x ¼ inch pin.

A number of examples of vibration with the necessary data are referred to in Electrical World, Vol. 66, No. 25, p. 1356. Computation shows in three of the cases cited that the Kinetic Energy developed by machinery vibration on bodies of similar size and weight would be greater than due to any case of blasting at Winchester, Mass. In one case the Kinetic Energy was 31 times as great and in another 6 times as great, yet observation failed to note any structural damage whatever.

Another interesting case was that of a record of a man walking in a house, following one taken of a blast. In this case the values were

A = .0036 inch v = 0.25 inches per second
n = 22
2 = 5.7 feet per sec. per sec.

The amplitude of motion is less than most of the blasting records.

n is much higher than in any of the blasting records but

a is larger than found in any case of blasting, but V is very small.

The Kinetic Energy on a 15 x ¼ inch pin is about 40 per cent the amount caused by the worst case of blasting which is the true basis of comparison. The fact that "a" is larger than in any case of blasting taken alone is not significant.

Method of determining whether or not pins will tip over due to vibrations:

The amount of work expressed in inch lbs. necessary to tip over a pin is closely, $\frac{wd^2}{4}$

The exact expression is somewhat difficult to employ, and as the approximate expression $\frac{wd^2}{4}$ is very close for pins having a value of h = height, several times the magnitude of d = diameter, it is quite satisfactory for practical use.

The amount of Kinetic Energy set up in the pin by any motion, including vibration motion is,

$\frac{Wv^2}{2g}$ in which $W = wh$ and $v^2 = aA$

$\therefore \frac{Wv^2}{2g} = \frac{wd^2}{4}$

$\frac{s\,h\,v^2}{2\,g} = \frac{wd^2}{4}$ from which

$v^2 = \frac{gd^2}{2h}$

$v^2 = aA = \frac{193.2\ d^2}{h}$ and

$v = \frac{13.9d}{Vh} = \frac{13.9d}{Vh}$

This is the velocity such that the Kinetic Energy just equals the amount of work required to upset the pin.

W = weight of pin in lbs.
w = weight of pin per lin. inch.
h = height of pin in inches.
d = diameter of pin in inches.
v = maximum velocity of pin during vibration in inches per sec.
= acceleration due to gravity
g
= 32.2 ft, per sec. per sec. = 386.4 inches per sec. per sec.
a = maximum acceleration of pin during vibration in inches per sec. per sec.
A = maximum single amplitude of motion in inches.

Assume a 15 inch pin, then the velocity of motion required to tip it over is,

$v = \frac{13.9 \times \frac{1}{4}\text{ inch}}{V15''} = .9$ inch per second.

In the case of the residence referred to above which shows the worst situation in regard to effects of quarry blasting the maximum value from the seizmograph were A = .0127 inches a = 4.24 feet sec.^{2} n = 10 from which v = 2nnA = 6.2832 x 10 x .0127 = .80 inches per sec. or an amount just below that required to tip over a 15 x ¼ inch pin.

The type of building considered in the investigation outlined above has been that of a comparatively low kind in which the ratio of height to width would be somewhere near unity and no considera-

tion therefore has been given to the question of a natural period of vibration of the building itself. If the structural stability of chimneys or very high buildings is to be considered it will probably be necessary to introduce the matter of the natural period of vibration of the structure inasmuch as the building movement will be increased when induced and natural periods of vibration are approximately the same, and the movements will be retarded when the induced and natural periods are quite different.

It has been shown that vibrating motion caused by well hole blasting as conducted at Winchester, Mass., produces stresses in structures far below the safe values commonly used in design. It is, however, a common phenomenon to find cracks, distortion and damage to plaster in practically all buildings and particularly in residences of an ordinary or cheap type of construction, and entirely regardless of their location in proximity to quarries or not.

A study of vibrating motion shows that it consists of motion rapidly alternating in opposite directions. Therefore all the results of this motion such as force, acceleration, velocity and stress are also alternating in opposite directions and these respective quantities are of exactly the same intensity in each direction.

It is a well known principle in structural mechanics that shear cracks in beams always start near the largest transverse forces or reactions and traverse the beam by angles approximately 45° with the neutral axis of the beam. These cracks are shown in Fig. 3 in full lines.

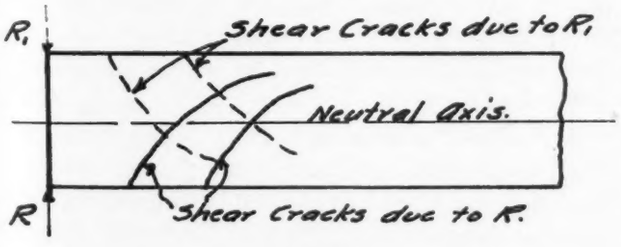

Figure 3.

If the shear is acting down as shown in dotted lines by R, then the shear cracks are shown also in dotted lines. If sufficient to cause cracks, equal reversing forces as R and R, will cause cracks approximately at right angles to each other and approximately at 45° to the neutral axis.

Those of you who have seen earthquake damage or even pictures of cracks caused by earthquakes will recognize immediately that cracks crossing approximately at right angles are a distinctive characteristic of vibratory motion if sufficient to cause any damage at all and that the phenomena of cracks in one diagonal direction only indicates forces or movement in one direction only which are usually caused by settlement.

One particularly interesting illustration of this occurred in a certain residence which I personally examined even using a level to accurately determine the amounts of settlement in the floors and partitions. This residence was 26 x 42 feet in plan and a beam support on Lally columns was carried through the center of the building over the cellar on the long axis. On this beam joists were supported from the side walls over which two layers of flooring was fastened. On the flooring a 4 x 2 inch strip of timber was laid on which 4 x 2 inch studs were erected for the partition which was carried up through three stories.

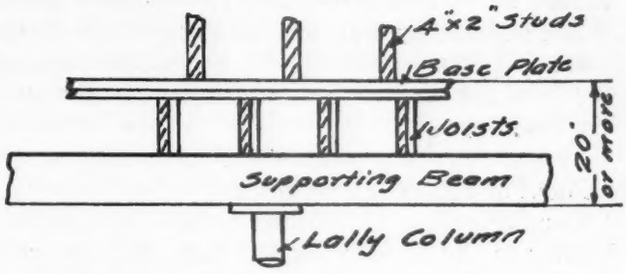

Figure 4.

In addition there were two furnaces in the cellar, one on each side of the center beam and very close to it. Please note that there is about 20 inches in depth of timber laid sidewise on the grain, or transversely, supporting the partition, while the outer walls were supported on studding resting on a base plate with only about two inches of transverse timber.

The important fact to be noted here is that the coefficient of shrinkage in timber transversely to the grain varies from 3 to 10 per cent while longitudinally the coefficient of shrinkage is about 1/10 of 1 per cent or from 1/30 to 1/100 as much depending on the kind of lumber used.

The same construction using lumber laid transversely was employed at the second and third floors.

Level measurements showed that the middle partition at its center point had dropped ¾ inch at the first floor, 1⅛ inches at second floor and 1⅝ inches at third floor and paint marks on the brick chimney running up through this partition checked closely these amounts. Using a coefficient of transverse shrinkage of 4 per cent for southern pine the probable shrinkage and therefore settlement of the partition at its center was very closely checked.

A proof that this settlement was caused by shrinkage was afforded when measurements taken in June with a damp cellar and no fire in the furnaces showed that due to dampness the partition had risen again about ½ inch from its position in February when the furnaces had thoroughly dried out the basement framing. The result of this settlement was equivalent to applying upward shearing forces at the wall supports and there were

characteristic shear cracks in one direction only in the plaster on the partition at each end near the wall supports. The movements and resulting forces on the partition were about 110 to 120 times as great due to timber shrinkage, as could possibly have been due to earth vibration and were entirely sufficient in amount to satisfactorily account for the damage.

Another type of crack in the outside stucco walls was found in which the cracks were near the corners of the building perpendicular and parallel to the edges of the wall. Being perpendicular these cracks were manifestly not shear cracks nor ones caused by vibratory motion. The stucco was not reinforced in any way and a consideration of the coefficient of expansion due to temperature change (0.00006 per degree F) fully accounts for such cracks.

Cracks in ceiling plaster may be caused by settlement of connecting partitions.

Usually ceiling cracks are parallel and perpendicular to the direction of the laths and are commonly due to contraction of the plaster itself or to the contraction or shrinkage of the lath itself. Fine hair line cracks in ceilings sometimes occur and these are quite frequently due to fine particles of unslaked lime in the plaster.

Cracks in foundations and rubble masonry of all kinds are quite often due to the use of lime mortar which has deteriorated through age, become soft and fallen out leaving openings and large cracks, superficially ascribed to other causes.

I know of a rubble built college chapel built with lime mortar years ago in which water leaked in at the eaves into the cornice construction so that literally barrels of soft mortar like mud had to be taken out and replaced by modern cement mortar in order to save the structure and also I know of another case of a large rubble built church in which the tower began to have stones drop out and fall due to the same cause.

Types of Electric Detonators

Practically all electric detonators now used in the United States are of the low-tension type. Those most used have a copper capsule, having fulminate of mercury as the main constituent of the detonating charge, and have a sulphur-composition plug to support the leading-in-wires and the bridge wire. The present practice in the United States is to use only three strengths of detonators, namely, Nos. 6, 7, and 8. The relative strengths of these three sizes are shown by the weights of the detonating charge in each, which are as follows: No. 6, 1 gram; No. 7, 1½ grams, and No. 8, 2 grams. This difference in the amount of charge and the consequent difference in the length of that part of the copper capsule constitute the only difference between the three strengths of detonators of the same type. The same bridge-wire elements are used in each of the different sizes. Manufacturers usually pack their detonators in boxes having different-colored labels, each size of detonator having its special color, so that the size of the detonator may be known at a glance. For firing shots at a considerable distance under water, special "submarine electric detonators" are sometimes used.

Unexploded Charges in Drill Holes

Some gelatin dynamites become insensitive with age, and in consequence occasionally a part of a charge fails to explode and remains in the bottom of a drill hole, states the Bureau of Mines, Department of Commerce, in Technical Paper 400, recently issued. When this happens the unexploded part of the charge is detected by a close inspection of the face, for its presence is not indicated by a count of the exploding charges of the round or by the fuse sticking from the hole. In hard ground where the rounds do not always break bottom, a stick or two of explosive left in the bottom of a hole may be overlooked; although drilling or picking into such explosive does not always cause it to detonate, a number of serious accidents have occurred from this cause. An explosive insensitive to detonation by ordinary detonator is always a source of danger when used underground. Explosive left in a hole because the outer part of the charge was cut off by preceding shots is more dangerous than explosive left because it was too insensitive to detonate with the rest of the charge. There is a likelihood that a detonator may be in the charge that was cut off.

In shafts it is more difficult to take care of misfires; the broken rock from other charges falls into the holes and must be removed before reblasting—always a dangerous proceeding. Generally the rock is removed from the holes by blowing out the fine material with compressed air or with water under pressure introduced through a pipe. This procedure seems less hazardous than leaving the unexploded charge in the hole and drilling around it. It would seem to be good practice to use clay stemming in the form of cartridges in all "down" holes, because after a misfire the clay could be removed more safely than broken rock. The general practice is to blast all missed holes or unexploded portions of charges whenever found, before any drilling or picking down is done at the face. In the past, accidents have occurred by removing unexploded charges from drill holes, but this practice is largely abandoned, and the safety rules of most mines prohibit it.

PIT AND QUARRY RESOURCES OF SEABOARD AIR LINE RAILWAY TERRITORY

THE Seaboard Air Line Railway crosses three well recognized physiographic provinces, the Appalachian Valley and Plateau Province, the Piedmont Plateau Province and the Coastal Plain Province. Geological formation of all ages from the Archaen to the present occur in these provinces. Dr. F. H. H. Calhoun, Consulting Geologist, Clemson College, South Carolina, has made a detailed study of the geological resources of this territory and his findings have been compiled in a booklet entitled "Geological Resources Seaboard Line Railway Territory." This booklet is the source for the information presented here.

The Seaboard crosses the first province between Birmingham, Alabama and Dallas, Georgia, a distance of about 135 miles. In this area are found red iron ore, brown iron ore, cement materials, coal, clays, building stone, road materials, bauxite, bariti and ochre. From Dallas, Georgia, through Atlanta, Greenwood and Chester, South Carolina to Hamlet and Rutherfordton, North Carolina, the Seaboard lies entirely within the Piedmont Plateau Province. In this area pyrite, gold, copper, granites, building stone, mica, koalin, feldspar, talc, soapstone and building materials are found. From Columbia, South Carolina to Hamlet and Raleigh, North Carolina, and to Richmond, Virginia, the Seaboard runs very near the Fall Line for part of the time on the Piedmont Plateau and part of the time on the Coastal plain. Within this distance, coal, sand and gravel are found in addition to the products previously mentioned. The remaining part of the Seaboard lies entirely within the Coastal Plain area. Phosphate, rock, marl, limestone, sand and gravel, kaolin and clays are the principal resources. For many of these materials, the demand is large and constantly increasing. Local demand and the diminishing supply elsewhere makes it timely to develop some of these resources.

There are many select deposits along the Seaboard Air Line Territory and a few of these of particular interest to Pit and Quarry readers will be mentioned.

The Chickamauga limestone outcrops in a broad belt about one half mile east of Odenville. This rock has an ideal composition for agricultural purposes and for the manufacture of cement. Shale in sufficient quantities and of the proper composition for cement manufacture is available in the Floyd series of the Mississippi formation. A cement plant at Ragland uses limestone from this Chickamauga outcrop.

Limestone is also available at Ohatchie, Tredegar, Prices, Rockmont and vicinity. There is a large amount of high calcium limestone available for ore. The limestone at Tredegar is found in two parallel ridges about one half mile apart. At three points within a mile of Tredegar, there is a sufficient amount of high grade stone to warrant development on a large scale. In many places, the limestone occurs in cliffs one hundred and sixty feet high and with less than the usual amount of overburden. The deposit of limestone at Prices lies under a shale outcropping. The shale is ideal for the manufacture of face brick. Limestone occurs at Rockmont and at several localities between Rockmont and Cartersville on the Cartersville branch of the eaboard. One of the largest crushed stone plants in the south is being operated at Ladds. Several other deposits can be utilized in a similar way, notably at Taylorsville.

Florida is essentially a limestone state and this limestone is divided into hard and soft rock. Limestone is being quarried at many points in Florida and deposits outcrop in sufficient quantities to be mined at Sumterville, Brooksville, Wiscon, Ringgold, Brunson and Bradenton.

A number of sand and gravel deposits are available many of them of an unusually coarse sand. About a mile and a half northeast of the town of Statham, Georgia is a deposit of anthophyllite asbestos. This asbestos outcrops along the side and top of a low hill. This asbestos is anhydrous and especially adapted for making chemical filters. Several deposits of bauxite are available particularly from ten miles north of Rome, Georgia through Rock Run, Alabama. Abundant granite is to be found in the Oglesby Elberton granite area of Georgia. This area is fairly well developed as several large and many small granite companies are now operating in this territory.

Readers interested in the Pit and Quarry resources along the Seaboard Air Line Railway desiring more or detailed information are invited to write PIT and QUARRY for the information which is available.

Sales of Slate in 1926

The value of the slate sold at the quarries of the United States in 1926 was $12,030,000, according to estimates furnished by producers to the Bureau of Mines, Department of Commerce. This was 4 per cent less than the value reported for 1926. Slate reported sold for electrical, structural and sanitary, and miscellaneous uses (chiefly flagstones) showed increase in both quantity and value, while the other products decreased.

The roofing slate sold amounted to 455,000 squares, valued at $4,832,000, a decrease of 8 per cent in quantity and 5 per cent in value.

(*Continued from page 96*)

better equipped they are to serve the truck trade without delays.

Regarding the question as to whether a plant should be constructed of wood, steel, or concrete, we are getting into a subject, whose merits depend greatly on the locality, type of plant and the probable life of the deposit. However, when large storage bins are required, I know of no more commendable way to advertise the fact that we are manufacturers of concrete aggregate, than to build our bins of concrete. The circular type of concrete bin can be built very economically from standard steel forms and can be arranged for very efficient loading. Our own recent plants, all being of the more skeleton type of design, with little or no storage, are of structural steel with heavy concrete footings.

After the features which have now been discussed, are weighed and the most suitable method selected for each step in the operation, the last and only point left, of sufficient importance to mention, is whether or not to house it all. Without question it pays, especially in the more northern states. We find that on account of protecting our machinery from the weather and making better working conditions for our employees, the housing is very much worth while. Equally important is the installation of ample chain hoists hung on I-beam trolleys in the tops of both the screen house and the crusher room. They should be located directly over the center of the heaviest machinery and of sufficient design to permit any part of any machine being lifted and moved outdoors. These hoists and trolleys pay for themselves during the erection of the plant, and are indispensable when repairing and replacement starts.

In conclusion, I can only say that in designing a gravel plant, the geographical location as well as the nature of the deposit, exact serious individual study. Each of you know best the conditions surrounding your own operations. For days, months, and years, you have studied your plant problems and made corrections necessitated by your environments. On a thousand different nights you have gone to sleep and awakened with a redesigned picture of your plant in your mind. It would therefore be presumptuous of me, to attempt to tell you how to build a gravel plant, without first taking into consideration the actual experience which you have had with the products from your deposit, under your prevailing conditions in your market.

(*Continued from page 86*)

Sutton, E. Guy, Neal Gravel Co., Mattoon, Ill.
Swalley, W. C. & Mrs., G. H. Williams Co., Erie, Pa.
Swanson, G. S., G. H. Williams Co., Pittsburgh, Pa.
Swisher, Don B., Zanesville Washed Gravel Co., Zanesville, O.
Sykes, H. R., Mid-West Loco. Works, Cincinnati, O.
Thistlewaite, J. M., Symons Bros. Co., Chicago, Ill.
Thompson, Scott, Ohio River Sand Co., Louisville, Ky.
Tiemeyer, W. H., C. Taylor Handman Co., Cincinnati, O.
Tishon, W. A., River Sand Co., Steubenville, O.
Tompkins, E. S., Allen Cone Co., New York, N. Y.
Tompkins, G. H., Sauerman Bros. Inc., Chicago, Ill.
Turley, A. P., Ohio River Gravel Co., Parkersburg, W. Va.
Turner, Jack, Barber-Greene Co., Aurora, Ill.
Wade, Newton B., Menantico Sand & Gravel Co., Millville, N. J.
Wagoner, J. H. & Mrs., Boonville Sand Corp., Utica, N. Y.
Waller, Stanton, Nat'l. Sand & Gravel Assn., Washington, D. C.
Warner, R. B., R. B. Warner Co., Cincinnati, O.
Watkins, J. S., Ky. State Highway Dept., Frankfort, Ky.
Weaver, Chas. W., Byers Machine Co., Dayton, O.
Welch, Frank M. & Mrs., Greenville Gravel Corp., Greenville, O.
Weldon, R. A., The Good Roads Machy. Co., Chicago, Ill.
Weston, N. A., Link-Belt Co., Chicago, Ill.
White, G. M., Good Roads Machinery Co., New York City.
Will, R. C., Midland Barge Co., Midland, Pa.
Williams, Thomas F., Fitzpatrick Sand & Gravel Co., Worcester, Mass.
Thornbury, Loretta, T. J. Hall & Co., Cincinnati, O.
Williamson, Geo. H., J. K. Davison & Bro., Pittsburgh, Pa.
Woellert, C. H., The Doermann-Roehrer Co., Cincinnati, Ohio.
Wroe, W. T., Morrow Mfg. Co., Welston, O.
Yager, P. A., River Sand & Gravel Co., Owensboro, Ky.
Yingling, Roy A., Perfect Classifier Co., Inc., Nashville, Tenn.
Young, C. M., Cincinnati Rubber Mfg. Co., Cincinnati, O.
Zange, Max, J. N. Dugan, Cincinnati, O.
Zannerman, Earl & Mrs., Ohio Gravel Ballast Co., Cincinnati, O.

Comments on Sand Lime Brick Prospects

T. C. Taylor, president, Sand Lime Products Company of Detroit, writes an interesting letter concerning conditions of his sand lime brick business. We quote from his letter:

"While the first half of 1926 showed considerable loss in business volume and also in average selling price of our brick, as compared with 1925, we closed the year of 1926 with greatly improved conditions. September, October, November and December sales were greater in both quantity and value as compared with the corresponding months of 1925. November and December showed increases over the previous year in average selling price, of seven cents and thirty cents respectively.

"With the first half of January past, the evidence is that sales will exceed January of last year by a large margin, and the average selling price by more than 40 cents. Last year at this time we had over 500,000 brick on hand. We now have less than 100,000—about two days output. Our plant is operating six days per week and eight hours per day. Arrangements are being made for night and day operation beginning with the opening of the spring rush in March.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20c each. State number of patent and name of inventor when ordering.

1,610,345. Pulverizing apparatus. Wister C. Williams, Decatur, Ill., assignor to McLaughlin Coal Reduction Co., same place.

1,610,350. Separator-screen. Emil W. and Guss Anderson, Seattle, Wash.

1,610,353. Screen. John Bland, Chicago, Ill.

1,610,502. Excavator. James G. and John W. Fairbanks, Marion, Ohio.

1,610,570. Knockdown and portable combination form and traveler for constructing inclined concrete arches. Charles P. Milburn, Los Angeles, Cal., assignor of one-half to Bent Bros., Inc., same place.

1,610,572. Lime hydrator. Hugh Miscampbell, Duluth, Minn.

1,610,864. Cement, concrete, and plaster. Victor Lefebure, London, England.

1,610,996. Reenforced concrete. Herbert S. Bruckshaw, Bolton, England.

1,611,026. Crushing and screening apparatus. Carl A. Gustafson, Minneapolis, Minn., assignor to Russell Grader Mfg. Co., same place.

1,611,094. Machine for manufacturing blocks, etc. Sherburne H. Wightman and Thomas A. Long, Chicago, Ill., assignor to International Concrete Industries Corporation, same place.

1,611,128. Apparatus for making and handling aggregates. John H. Gunnison, Madison, Wis., assignor to Russel Grader Mfg. Co., Minneapolis, Minn.

1,611,195. Excavator. Anton F. Jelen, Kankakee, Ill.

1,611,254. Separator. Thomas J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Boston, Mass.

1,611,255. Separator. Thomas J. Sturtevant, Wellesley, Mass., assignor to Sturtevant Mill Co., Boston, Mass.

1,611,297. Machine for making concrete or the like. Andrew Wickey, East Chicago, Ind.

1,612,066. Cutter-head for mining-machines. Charles W. Shanaberger, Indiana, Pa.

1,612,095. Apparatus for the manufacture of cement tile. James Brown, New Castle, Pa., assignor to American Cement Tile Mfg. Co., Pittsburgh, Pa.

1,612,175. Crushing-machine. Swinfen Bramley-Moore, White Plains, N. Y., and John McIntyre, Portobello, Scotland.

1,612,288. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,612,502. Grinding-roll chair. Johann A. W. Fickenscher, Dresden-Blasewitz, Germany.

1,612,764. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., Same place.

1,612,808. Artificial marble. Paul Golfinopulos, Reading, Pa.

1,613,341. Process of producing hydrated lime. William E. Carson, Riverton, Va.

1,613,631. Actuating mechanism for molding machinery, George Weiss, Chicago, Ill., assignor to International Concrete Industries Corporation, same place.

1,613,663. Mixing apparatus (a lime-treating apparatus). Frederick B. Leopold, Pittsburgh, Pa.

1,613,682. Apparatus for making plaster and mortar. Albert E. Tuttle, Boston, Mass., assignor to Blue Diamond Materials Co., same place.

1,613,846. Machine for mixing cementitious materials. David W. Pye, Brooklyn, N. Y.

1,614,033. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,614,034. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,614,035. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,614,287. Mining-machine. Kenneth Davis, St. Benedict, Pa.

1,614,384. Sand and other riddle or sieve. William M. O'Keefe, Birmingham, England.

New Incorporations

Mantua Sand & Gravel Co., Mantua, O. $5,000. A. W. Heinrich.

Ullin Crushed Stone Co., Room 708, 111 W. Jackson Blvd., Chicago, Ill. $350,000. Deal in leaseholds, develop and work stone quarries and quarry sites. Dr. Orlando F. Scott, O. S. Scott, R. W. Sanderson, Harry Culver, I. Katz. Corr., Murphy O. Tate, 31 S. Clark St., Chicago.

Certified Sand Co., New Haven, Conn. $100,000. Ray J. Reigeluth, Harold C. Blakeslee, Albert L. Worthen, Milton C. Mapes.

Sierra Lime Co., Sacramento, Calif. $100,000. To trade in lime and lime products and mine rock and marble. Directors: Allen F. Grant, J. F. Dunasky, Charles J. Eastman.

Beyer Crushed Rock Co., 48th and Agnes Sts., Kansas City, Mo. $90,000. W. M. Beyer, 2027 Swope Parkway. To quarry stone and gravel.

Frank J. Boland, Inc., Union, Broome Co., N. Y. $100,000. Granite, stone, gravel, building materials. F. J. Boland, 2 Grand Ave., Binghamton, N. Y.

Puget Sound Marble & Granite Co., Seattle, Wash. $10,000.

Downer Silica Co., Downer, N. J. 1,000 shares n. p. v. Sand and silica. (Holding Company for S. W. Downer, under whose name the firm will operate, as for 24 years past.)

White Plains Washed Sand & Gravel Co., Mamaroneck, N. Y. $15,000. A. M., E. W., E. H. Gedney. (Filed by E. L. Howe, Mamaroneck.)

Independent Gravel Co., Seattle, Wash. $100,000. R. E. L. Thomas, David E. Sayre, Ivan L. Hyland.

Freeman Stone & Gravel Co., Inc., Norfolk, Va. $1,000 to $5,000. M. W. Freeman, Pres.; F. M. Freeman, Secy.; W. H. Freeman. (Attorneys, Merrill & Machen, Norfolk.)

Paramount Brick Works, Inc., Manhattan, N. Y. $300,000. Brick, stone, cement, etc. Delia Liberman, 129 Miller Ave., Brooklyn, N. Y.

Silica Sand Co., San Antonio, Tex. $40,000. Directors: G. H. Piper, Central Trust Bldg.; Harry J. Hatch, 248 Blum St.; A. H. Piper, City National Bank Bldg.

Sherman Stone Mfg. Co., Inc., Houston, Tex. $10,000. C. T. Sherman, Geo. B. Stone.

Standard Asbestos Co., $50,000. H. A. Hirschfield, C. H. Weaver, H. A. Schumacher. (Filed by A. H. Schwarz, 570 7th Ave., New York City.)

Scotia Stone & Gravel Co., Schenectady, N. Y. 1,000 common, n. p. v. L. and A. Lantanzio, H. E. Blodgett. (Filed by Blodgett & Smith, Schenectady.)

Moosic Sand & Gravel Co., G. W. Bone, Scranton, Pa. $15,000. (Capital Trust Co. of Delaware.)

Phoenix Products Co., Inc., Newark, N. J. Concrete materials. $125,000. Charles H. Cox, Phoenixville, Pa.; Van Vliet Green, Bloomfield, N. J.; Mildred E. Bouscher, Newark, N. J. (Attorney, James L. Garabrant, Newark.)

R. I. Graphite Corp., Jamestown, R. I. $50,000. To mine graphite. Fred Howard, 28 Ford St., Providence, R. I.; Ernest Bean, Arthur M. Harvey.

Harrison Asbestos Co., $10 000; C. E. Harrison, G. M. Burns, V. A. Price. (Filed by M. I. St. John, 27 Cedar St., New York.)

Keystone Tile & Marble Co., Philadelphia, Pa. $15,000. Harry Hirshfield, 3245 N. 15th St.

Gulf Coast Shell & Cement Co., Houston, Tex. $10,000. A. E. Wickham, J. E. Reed, C. S. Zerby.

FOR SALE OR RENT

All equipment overhauled in our Shop is furnished in guaranteed condition, subject to thirty days' trial in service.

STEAM SHOVELS—RAILROAD TYPE

1—95-C Bucyrus, Shop No. 1235, 5-yd.
1—Model 80 Marion, Shop No. 1312, 4 yd.
4—70-ton Bucyrus. Shop Nos. 920, 939, 977 and 1233. 2½-yd. dippers.
1—Model 60 Marion. Shop No. 2238, 2½-yd. dipper.
3—60-C Bucyrus. Shop No. 1286, 1388 and 1640, 2½-yd. dippers.
1—45-C Bucyrus. Shop No. 1202. 1¾-yd. dipper.

SHOVELS—FULL REVOLVING

2—50-B Bucyrus. Shop Nos. 3821, 4216, caterpillars, 26-ft. boom, 17-ft. stick and 1¾-yd. dippers. Oil burner.
1—37 Marion. Shop No. 4773, 32 ft. boom, 22 ft. dipper arm, 1¼-yd. dipper. Caterpillars.
5—Type "B" Eries, Shop Nos. 559 and 1027 have standard boom equipment. Shop Nos. 1484, 1614 and 2144 are high lift. All ¾ yard. Steel caterpillars.
1—Osgood 18, Shop No. 1002, standard boom, ¾-yd. dipper. Steel caterpillars.
1—Model 21 Marion. Shop No. 4294, steel caterpillars, ¾ yd.
1—Model 21 Marion Gas-Electric. Shop No. 4550, caterpillars, standard boom, ¾-yd. dipper.
1—Type O Thew, Shop No. 1777, high-lift, traction wheels, 2/3-yd. dipper.
1—18-B Bucyrus. Shop No. 1870, ⅞-yd. dipper. Traction.

SIDE DUMP CARS

9—30-yd. Western, all-steel, air dump.
43—20-yd. Western, all-steel, air dump.
12—18-yd. Western, all-steel.
95—16-yd. Western, wood beds, air dump.
72—12-yd. Western Side Dump, wood beds.
10—6-yd. K. & J. Steel Sills Truss-rod doors. Located Burmaugh, Ky.
19—4-yd. K&J, 36-in. gauge, wood sills.
12—4-yd. Western, 36-in. ga. heavy duty.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.

1—Std. boom, dipper arm and ¾-yd. dipper for Type "B" Erie.
2—32-ft. and 40-ft steel boom, drum, etc. for Type "B" Erie Crane.

LOCOMOTIVES

1—19x24 Baldwin 6-wheeled Saddle Tank. Shop No. 49553. Weight 67 tons, 180 lb. steam pressure. Air brakes.
1—18x24 American Six-wheeled Switcher. Shop No. 47677, weight 52 tons, 170 lb. steam pressure.
2—16x24 Davenport 4-wheeled switchers, Shop Nos. 858 and 860. Wt. 40 tons. Air brakes.
2—11x16 Vulcan 4-wheeled Saddle Tanks. 36-in. ga. Shop Nos. 1621 and 3411, wt. 21½ tons.
2—10x16 Davenport, 36-in. ga. 4-wheeled Saddle Tanks. Wt. 19½ tons. A. S. M. E. and Ohio Std. boilers. New 1922.
2—10x16 Baldwin, 36-in. ga., 4-wheeled Saddle Tanks. Wt. 19½ tons. Shop Nos. 12161 and 28353.
4—7x12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies.

DRAGLINE EXCAVATORS

1—Class 24 Bucyrus. Shop No. 859, equalizing trucks, 100-ft. boom, 3½-yd. Page bucket. A.S.M.E. boiler.
2—Class 20 Bucyrus Draglines. Shop Nos. 740 and 813, 85-ft. booms, 2½-yd. dragline buckets. Skids and rollers.
2—Class 14 Bucyrus, steam operated. Shop Nos. 2140 and 3706, steel caterpillars, 60-ft. boom, 2-yd. bucket. A.S.M.E. boiler.
1—30-B Bucyrus Shop No. 3641, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.
2—No. 2 Monighan steam operated. Shop Nos. 789 and 1587, skids and rollers, 60-ft. boom, 2-yd. Page bucket.
1—Model 210 P&H Gasoline Dragline, Shop No. 1077 Armored caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 21 Marion Gas-Electric, Shop No. 4550, caterpillars, 36-ft. boom, ¾-yd. Page bucket.
1—Complete Caterpillar arrangement for Class 14 Bucyrus Dragline.

SPREADER CARS

2—Std. Gauge Western Spreaders.

CRANES

1—Type "B" Erie. Shop No. 559, 36-ft. boom, bucket operating, ¾-yd. clam shell.
1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
1—20-ton McMyler, No. 388, 50-ft. boom, bucket-operating.
1—21-ton Industrial 8-wheeled Crane. Shop No. 2706. 50-ft. boom, bucket operating.
1—Type "B" 23-ton McMyler, Shop No. 3265, MCB trucks, 50-ft. boom, bucket-operating.
1—30-ton Industrial 8-wheeled MCB type. Shop No. 3261. 55-ft. boom with 20-ft. extension, bucket-operating.

BUCKETS

2—1½-yd. Page Dragline Buckets.
1—2-yd. Page Dragline Bucket.
1—1-yd. Class "M" Page Dragline Bucket.
1—Class "H" 2½-yd. Page Dragline Bucket.
1—1½-yd. Mead-Morrison Clam Shell.
2—1¼-yd. O. & S. Clam Shells.

MISCELLANEOUS

1—10-ton Austin 3-wheeled Gaso. Roller.
1—60-ton Lidgerwood Unloader with side plows.
1—No. 7-S Knickerbocker Concrete Mixer. with power loader and water tank on trucks. New.
1—American Railroad Ditcher No. 459.
1—8-ft. Austin Giant Road Grader.
1—6½x10 D.C., D.D. American Hoist, with butt strapped boiler.
35—Milburn Carbide Lights.
1—No. 55 Buhl Portable Air Compressor.
1—Set Pile Driver Leads. 42-ft. long.
12—New Drag Scoops.
1—Model 10 Keystone Mixer, low charger, 6 Hp. Novo Gas Engine.
1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.

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Locomotive Crane

1—20-ton Brown Hoist, 8-wheel, New, 1922. 60 in. dia. boiler—55 ft. boom. Double drum. Perfect condition.

Gas and Steam Crawlers

1—Model 105 Northwest. New 1925. 40 ft. boom.
1—12-ton Link-Belt. 50 ft. boom. New 1924.
1—Type B Erie Combination. ¾-yd. steam shovel with 30 ft. crane boom. Used 2 years.

Steel Derricks

6—5-ton all steel stiff leg derricks for permanent installation. 50 to 70 ft. booms.

Hoisting Engines

2—8¼x10 Lidgerwood D.C. DD oversize. ASME boilers. Used 90 days.

Steam Shovels

1—Model 37 Marion, new 1923, caterpillar mounted, 32' boom, 22' stick, 1¼ and 1¾ dippers, exceptionally fine condition.
1—Model 32 Marion. New 1923—Caterpillar mtd. 24 ft. boom. 20 ft. stick. 1¼ yd. dipper. Rebuilt.

Dump Cars

11—12 cu. yd. Western, standard gauge, Air Dump Cars, all steel bodies, fine condition.
6—12 cu. yd. Western Air Dump Cars, wood bodies, condition like new.

Locomotive Type Boilers

1—125 H.P. Penna. Locomotive Type Boiler ASME code, 125 lbs.
1—100 H.P. Farquhar ASME code, 125 lbs.

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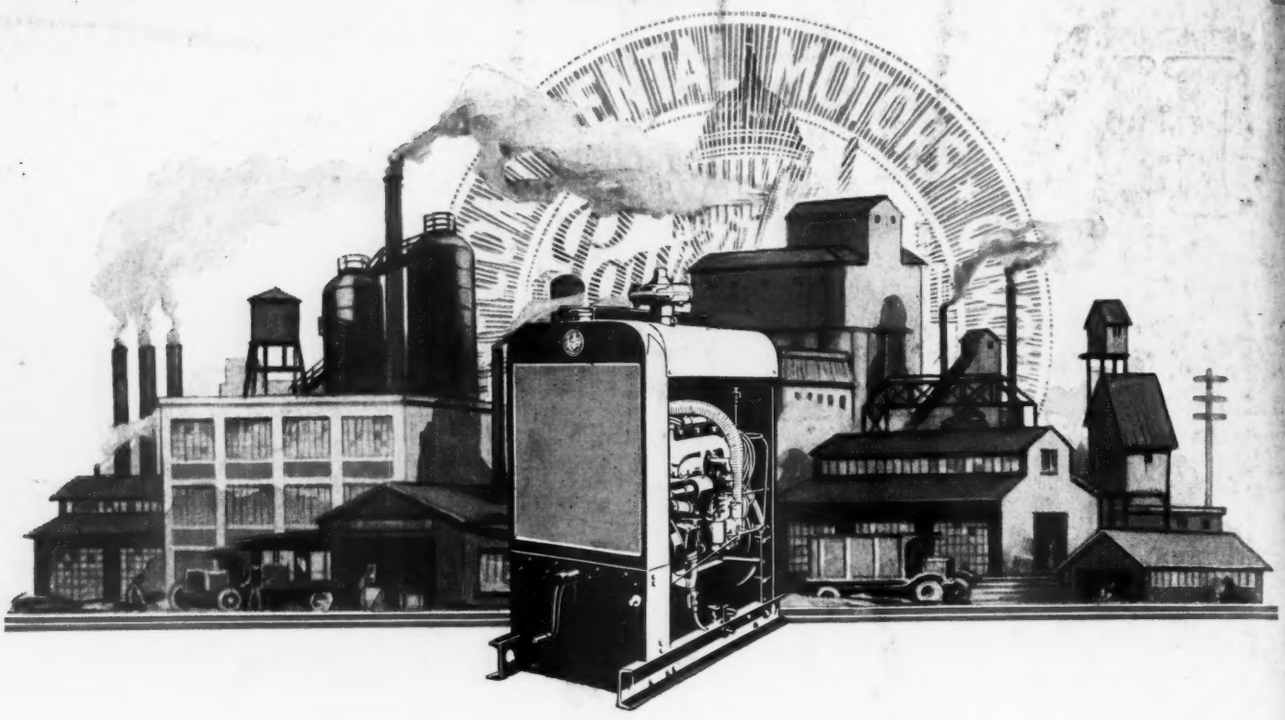

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